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The Effect of Natural Disasters on Minority Voter Turnout, 1990-2016

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Approval of the Dissertation Committee

This dissertation has been duly read, reviewed, and critiqued by the Committee listed below, which hereby approves the manuscript of Gary Hawk as fulfilling the scope and quality requirements for meriting the degree of Doctor of Philosophy in Economics and Political Science.

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Abstract

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This paper studies four natural disaster categories—climatological, geophysical, hydrological, and meteorological—and their impact upon four elections—gubernatorial, House, President, and Senate—for the 1990-2016 time period in 3,113 US counties, excluding Alaska. The research focused on which natural disasters impacted minority voters—Asians, Blacks, Hispanics, Native Americans, and Two or more races—if disasters affected the individual elections. Natural disasters provide mixed results on US election outcomes depending upon disaster, election, and the minority group.

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1 Introduction

Natural disasters are a part of life on planet earth. Since humans earliest writings, disasters are part of human history. Some of the earliest stories of recorded history are the hydrological Sumerian flood of Gilgamesh and the Biblical flood. These records continued through the writings of Voltaire and the geophysical November 1755 Portugal earthquake and tsunami with the accompanying destruction of Lisbon. The events of natural disasters are both local and international events e.g., the 2004 Indian Ocean earthquake and tsunami killed over 227,000 people and impacted 15 countries, Mt. St. Helen's eruption in Washington state in 1980 killed 57 people with volcanic ash extending to Edmonton Alberta, Canada. The "Little Ice Age," a climatological disaster, impacted the Northern Hemisphere for nearly 500 years from about 1300 to 1850. In recent memory were two different destructive disasters. Thirty years ago, 17 January 1994, a ferocious 6.7 Richter earthquake caused $\$\pm 30$ billion in damages (1994 dollars) in Northridge, CA and meanwhile the state still awaits the "Big One." Hurricane Michael (2018), was a storm for the record books and was more powerful at landfall than hurricanes Katrina or Andrew striking the states of Florida, Georgia, North Carolina, South Carolina, Virginia, and Maryland on October 10, a few weeks before the 2018 elections (Rice, 2018).

The election disaster nightmare became a reality befor the Super Tuesday presidential election of March 2020. Late Monday 2 March and in the predawn and early hours of election day Tuesday 3 March, supercell thunderstorms (a least common type of thunderstorm that produces severe weather, damaging winds, very large hail, and sometimes weak to violent tornadoes that may last for several hours) caused tornadoes across Southeast Missouri, southern Kentucky, Tennessee, and central Alabama. An EF-3 tornado (136-165 mph winds) travelled over 60 miles across Middle Tennessee causing destruction with hundreds of injuries and 25 fatalities (NOAA, 2020). Davidson County, TN had to relocate 15 polling stations, and some of them required electoral generators, a few election workers were trapped in their homes, and a judge extended polling station hours (Gee et al., 2020). This event demonstrates the saliency of this study. Disasters happen randomly, oftentimes without much or any warning, and cause havoc and they will and do impact elections and voter turnout.

What about the voters when a disaster strikes? Depending upon the disaster many voters are forced to evacuate because their homes are uninhabitable. Forced to flee under extreme duress the possibility exists of failure to retrieve important identification documents needed to vote. Whittington-Kaminski (2019) writes, “Hurricanes are becoming as frequent as elections, after all, they are in the same season.” This is not just true of hurricanes as the 2020 Super Tuesday tornados showed.

> On top of an already challenging election year because of the ongoing pandemic and a polarized political landscape, climate catastrophes present yet another obstacle to the polls. As of October 26, an estimated 6,000 Lake Charles resident have yet to return to their homes since evacuating in late August—and again in October—to escape back-to-back hurricanes. In New Orleans and other parts of Louisiana hit by the most recent hurricane, Zeta, polling places have been affected by widespread power outages.
>
> On the West Coast, entire communities have had to evacuate to shelters and other parts of their states in California, Oregon and Colorado due to unprecedented wildfires. In some cases, Covid-19 adds an extra layer of complexity as traditional shelters were closed (Poon, 2020).

Coupled with these living conditions, as noted above, from natural disasters the cost of voting is higher for those people who are lower in socioeconomic standing. These hurricane and wildfire survivors have lived as refugees, many living without jobs, and then have to face either registering to vote or voting. This cost of voting, for disaster victims includes indirect information costs, the direct costs of lost wages and time in both registering and the physical act of voting, appears probabilistically insurmountable. The usual factors—socioeconomic status, race, education, and demographics—are the common factors when political scientists study the inequality of political participation as these elements favor those over those who are the less advantaged citizens (Lijphart, 1997; Vowels et al., 2017). Debate will continue if these usual variables are the correct way to measure political inactivity but this study shows natural disasters do have a role in the equation's theoretical list of variables.

These disasters offer a "natural" experiment into voting behavior by analyzing the voter turnout ex post the disaster and ex ante under ceteris paribus. Obviously, no study can get inside the minds of voters but the turnout votes do provide an example of what the majority of voter's opinion is about the two candidates. As the literatures shows, voters will either punish or reward the incumbent for the actions taken during and after the disaster before the election (Abney and Hill, 1966; Arceneaux and Stein, 2006; Ashworth et al., 2018; Flores and Smith, 2012; Healy and Malhotra, 2010, 2009; Lay, 2009).

While some research has studied natural disasters at the macro or case level (Abney and Hill, 1966; Artés, 2014; Bodet et al., 2016; Gatrell and Bierly, 2002; Sinclair et al., 2011), this study focuses at the smallest measurement unit available, US counties over a 26 year time period. This research studies the microlevel county election turnout of four election types on various election cycles. This study's dependent variable (DV) is $\text{y1} = \frac{\text{total election race votes}}{\text{sum of potential population by race}}$ based on 3,113 US counties (Federal Information Processing Standards) FIPS code and House, President (POTUS), Senate, and governor elections for the time period 1990-2016. The model analyzes the time before a disaster t_0 and after a disaster t_{+1} with a difference in difference analysis for the 26-year period.

This study does *not* offer solutions to election day scenarios under natural disaster conditions but instead, shows how natural disasters impact electoral turnout of minorities and provides understanding in how natural disasters affect all races and ethnicities at times of elections. Why study minorities? Political power, as the literatures shows, favors citizens with money and time. Those with these resources possess advantages in political participation either as candidates or involved citizens. Minority populations because of their socioeconomic standing have less of those assets so the study of how natural disasters impact their voting behavior becomes salient. Natural disasters do affect citizens equally but minorities disproportionately compared to Whites. More importantly, in a close election, this study shows how a disaster impacts minority voter's turnout which could snatch a political victory from the jaws of defeat if candidates recognize this impact.

It follows with devastating disasters how such an event could impact an election. If the disaster occurred a short time before the election, citizens may not have the opportunity to register at the last minute, show proof of ID, election sites may no longer exist, and transportation becomes unavailable for voting participation. What would happen if the "Big One" struck California before a Presidential election? California has 55 electoral votes, enough to possibly influence a close election by impacting election turnout including the county or counties conducting an election. Such an impossible seeming idea then becomes an unforeseen Constitutional question. (Two interesting papers, James and Alihodzic (2020), (Morley, 2017) discuss postponing elections in the event of natural disasters or terrorist attacks.). The purpose of this study evaluates the impact of natural disasters on voting behavior. Chapter two discusses natural disaster literature relating to natural disasters and voting. Chapter three the theoretical approach to the research. Chapter four illustrates the election analysis and chapter five has the study's discussion and conclusions.

1.1 Research questions

The study of natural disasters covers a range of disciplines, all studying the prevention and impact of damages on social dynamics. Political science is the focus of research for this analysis. The research questions are:

- Which natural disasters have a statistically significant effect on minority voter turnout?
- Which natural disasters have a statistical significance upon the four major US elections: House, Senate, POTUS, and governor?

The purpose of these questions are two-fold. First, is obviously the natural disaster issue because natural disasters will occur and are non-preventable so which minority voting behaviors are the most affected. Second, minorities are typically lumped together into one variable in voting analyses regardless of the distinguishing differences between them. For example, Blacks generally do not have language barriers when compared to

Hispanics. Blacks born in this country speak English. Not all Asians and Hispanics have this opportunity. This study separates them for closer analysis. This separation allows comparisons and contrasts between racial groups and illustrates what Verba (1996) wrote that embedded in American society is political inequality which this study attempts to investigate. Democracy depends upon the relationship between government elites responsiveness to the citizens and equal responsiveness by citizens to the elites hence, one person, one vote. However, if the basic principle of voting breaks down democracy has, the ruled are ignored by the elites and the ruled ignore the rulers. For underrepresented or invisible citizens like minorities this can create major problems. If citizens withdraw from and withhold energy from political participation a major dilemma occurs and with certainty those more privileged citizens, i.e., higher incomes, more wealth and education, will fill the vacuum left by those not engaged.

Brady et al. (1995) shows that those who are more engaged in the political process may have two resources from those who disengage, time and money. These two resources quickly divide society, those who have and those who have not. Each of these two assets are further divided. Those with money have the discretionary funds and are less constrained in donating to candidates and parties and those without are restricted from the political process. The time to study candidates and issues, physically participate in rallies and meetings, again becomes available only to those who have either the ability to create time and not to those who lack time. People with excess can save, but time is one asset that is constantly used to completion. These two simple assets separate the rich, poor, and minorities in US elections. Of course, both assets are relative because one may have wealth and riches and no free time but can donate excess funds. Or, one can be poor and have free time, so time does not truly reflect socioeconomic status (Brady et al., 1995). Because education and income are correlated one can assume money separates those who are actively engaged in the political process and education also increases one's civic skills. The underlying assumption for this paragraph's framework is equal disbursement of political interest across citizens. This paper shows that under natural disaster conditions this assumption may not hold.

This research Lijphart (1997); Vowels et al. (2017); Verba (1996); Brady et al. (1995) shows that those from a lower socioeconomic status, i.e. minorities under natural disaster conditions, vote significantly less than Whites in terms of total population percentage. Minority groups also suffer the most from voter suppression laws by having less education, family income, wealth, and language barriers under ceteris paribus conditions. Consequently, these research questions has three assumptions. First, the assumption is the majority demographic race will vote regardless of disasters or not, so all minority races are compared to holding the white majority constant to the percentage of the total population. Second, Whites do not suffer from voter suppression. Third, natural disasters will have a statistical significance on voter turnout and fourth, different natural disaster categories, e.g., climatological and meteorological, will vary the statistical significance of minority voter turnout holding white voter turnout constant to the percentage of the total population.

These research questions are important in the research of natural disaster studies and furthers the research of Verba (1996); Lijphart (1997) and others. As Wuebbles et al. (2017) and NOAA (2019) have noted, natural disasters interrupt lives with severe consequences and these hypotheses address the issues natural disasters present in voting behaviors. Answering these questions will further natural disaster research.

1.2 Theoretical approach

The methodology used will involve studying the impact of disasters on voters and their ex ante and ex post participation in election cycles. This ex ante and ex post analysis uses the assumption from Riker and Ordeshook (1968): a voting cost exists as shown in the following equation.

$$R = PB - C + D \tag{1}$$

The theoretical equation variables are defined as follows: R is equivalent to the individual utility reward received from voting participation; P equals the citizen's probability they will vote with $0 \leq P \leq 1$; B stands for the voter's benefit in voting participation; the cost of voting is C; and D represents a positive expected utility for participating in the election outcome. Riker and Ordeshook (1968) state what most voters consider are the equation's two key variables, C (cost) and D (positive expected utility). The cost, a positive number, is subtracted from the product of probability and voter's benefit.

However, does the ceteris paribus equation conditions exist for natural disaster voting survivors? Intuitively one expects the greater the disaster will impact voter's $P \approx 0$. This study uses Equation (1) and focuses on C and the order of utility preferences relationships.

Assume three disaster victims, Alpha, Beta, and Charlie, suffering under the most devastating circumstance, i.e., loss of housing and income. Also assume, elections are held soon after the disaster. The fictitious voter victims have three possible preferences: voting in the election, or finding housing, or finding employment. A third assumption is Alpha, Beta, and Charlie are rational actors and their choices are independent.

Table 1: Three fictitious voting preferences

Alpha	Beta	Charlie
Housing	Voting	Job
Job	Housing	Voting
Voting	Job	Housing

None of the the choices of Alpha, Beta, and Charlie, are wrong, they only express the preferences of each of them. These choice orders provide varying degrees of utility to each of the imaginary actors (Mas-Colell et al., 1995). Alpha's voting equation below illustrates this concept.

$$R = PB - C + D \tag{2}$$

$$= 0B - C + D \tag{3}$$

$$= D - C \tag{4}$$

If Alpha has a zero probability of voting then equation (2) results into $R = D - C$ and Alpha will not vote because $C = -1$ assuming that D, the positive expected utility for participating in the election outcome, has a positive value after subtracting C, the cost of voting.

Beta's voting equation follows.

$$R = PB - C + D \tag{5}$$
$$= 1B - 0 + D \tag{6}$$
$$= B + D \tag{7}$$

Beta will vote because the variables $B =$ voters benefit, and $D =$ positive expected utility and positive coefficients. Beta's cost for voting has a value of $C = 0$.

Charlie has a 50-50 chance of voting preferences thus the probability for Charlie, $P = 0.5$.

$$R = PB - C + D \tag{8}$$
$$R = 0.5B - C + D \tag{9}$$

If B is halved the equation segment becomes $0.5B > -C$, then Charlie votes and the $D =$ positive expected utility, because of a positive value is ignored. If $0.5B < -C$ then Charlie will not vote. In this hypothetical example with a 0.5 probability, Charlie may or may not vote. Ergo, Charlie is indifferent in his voting utility. This preference by Charlie demonstrates the dilemma of disaster studies because a possibility exists the disaster event and the type of loss Charlie experienced will show the order of the ordered preference.

If Equation (1) $C = 0$, then $R = PB + D$ and the utility of voting will depend upon the probability of the individual preferences of the individual. Similarly, if $C = 1$, then $R = PB - (1) + D$ and any value of P (probability) results in a negative value and the voter will not vote because C has a negative sign. This simple proof shows for minorities, especially after a natural disaster event the probability of minority's voting are negative because of their socioeconomic status, language barriers, wealth, lacking political information, and voting registration laws. Each of the minority groups lowers the value of P in Equation (1) and the values between P and C diverge giving a negative value and thus creating a greater barrier after a disaster minority citizens must overcome to vote.

From Section 1.2 and the succeeding mathematical proofs the cost of voting depends upon the rational preferences of the fictional Alpha, Beta, and Charlie. The cost, C however, is always negative. The value of R, the individual utility reward from voting, will depend upon the negative C as determined by the individual preferences and the disaster losses the citizen has suffered.

How does Section 1.2 and Equation (1) work with minority voters? Minority voters have one of the three preferences after a disaster, housing, voting, and job, the same as Alpha, Beta, and Charlie. They also have the same negative cost. When destruction happens people will fight to survive the dramatic aftermath depending upon their rational preference individualized to their circumstances. Minorities will react the same way whether they are Asian, Black, Hispanic, Native, or Two or more races. One cannot assume otherwise. The difference for minorities compared to Whites is their socioeconomic status, language barriers, wealth, and education to overcome.

For citizens to vote the P (probability) and C (cost) have a direct negative relationship. With minorities having disadvantages in lower socioeconomic status, language barriers, and education, it equates $P < C$. To reverse the less than sign the probability must have a larger value than the cost to overcome the $PB - C$ portion of Equation (1) and provide a positive value for a citizen to vote. However, $0 \leq C \leq P$ and C will always have a negative sign. The other variables, R (individual utility reward), B (voter benefit for civic participation), and D (positive expected utility for participation) in Equation (1) are moot based on the preceding analysis. Why? If $P < C$ then R becomes irrelevant, there is no benefit in voting, and the positive expected utility of one's candidate or party winning has no value. Thus, the two variables P and C determine the values of the remaining variables.

For minorities this negative cost, C in Equation (1) along with their preferences especially after a natural disaster, has a greater negative value because of their lower socioeconomic status, language barriers, and education. These factors become more complicated if the minority lives as a disaster refugee, i.e., searching for housing and employment. Because Asians have higher poverty rates than all Americans this causes one barrier to enter political participation and potentially lowers the probability of Asians voting when compared to Whites in the percentage of Whites in the total population (Xu, 2002). Blacks too have similar issues and the cost of voting only intensifies this lack of civic interest because of their perception of the federal government's historical indifference and lack of responsibility to their plight after natural disasters (Rivera and Miller, 2007). Hispanics also suffer under natural disaster conditions but their heterogeneity provides group variation and they do vote less than Whites (Antunes and Gaitz, 1975; DeSipio, 1998; Highton and Burris, 2002; Fraga, 2016). Natives vote at the same level as Hispanics and Asians (Herrick et al., 2020).

Marginal costs need considered in the cost of voting as shown in Equation (1) Aldrich (1993) shows how the marginal cost of voting will decrease turnout. These marginal costs historically were increased voting registration laws, poll taxes, and residency requirements. How different then do these costs vary from the simple model in Section 1.2? If the cost of voting C is low then the benefits B will likely be low (Aldrich, 1993). Voting then becomes a marginal decision and has low costs and low expected benefits. However, in terms of a disaster, loss of housing and job, these low costs may skyrocket especially for minorities. Because minorities may not reap any benefit from voting this marginal cost, although not specifically identified in Equation (1), it may cost as little as the discomfort of standing in line in the rain, using extra gas to travel to the polling station, or having confronted life's personal problems. Some voters may consider these marginal costs expensive and thus not vote. The election race may constitute another marginal cost because of the saliency of the type of candidate. Voters may place a greater importance on the POTUS race compared to House or governor so the marginal cost may lower. In a non-POTUS election year the marginal cost may be higher for those electoral candidates.

2 Natural disasters and voting

Abney and Hill (1966) provide one of the first studies regarding natural disasters and voting. Hurricane Betsy struck southeast Louisiana on 9 September 1965 bringing flooding, destruction, and death. Betsy also was the first billion dollar damage natural disaster with $1.2 billion damage costs in Louisiana, Florida with $1.39 million, Mississippi $80 million, and Alabama $500,000 in damages. Betsy caused a estimated total damage of $1,433,800,000, in 1965 dollars (Sugg, 1966). Abney and Hill (1966) surveyed three small "dry" precincts and two larger "wet" precincts with wet defined as those areas where people were flooded out of their homes and dry as otherwise or no flooding in New Orleans. Using a logit model it appeared natural disasters are not automatically detrimental to the government in power.

Citizens may hold the government responsible after a natural disaster if in the voter's mind only the government can prevent the intensity of a natural catastrophe according to the survey data and logit model results of Arceneaux and Stein (2006). This study, Arceneaux and Stein (2006), was similar to Abney and Hill (1966) with the use of a logit model. Ashworth et al. (2018) studied the question of voter irrationality when non-political events outside their control effect electoral outcomes. They concluded natural disaster impacts do not have a sufficient inference that cause voters to behave irrationally. Healy and Malhotra (2009) shows voters reward the incumbent presidential party for delivering disaster relief spending. However the results change if the incumbent did not invest in disaster preparedness spending. This results in inconsistencies which distort public officials incentives and leads to disaster preparedness underinvestment.

Flores and Smith (2012) using de Mesquita et al. (2005) selectorate theory, claim in a large coalition of democratic systems the frequency of disasters has no effect on protests and leader survival, yet if many people die more protests occur and leader survival diminishes. In more autocratic small coalition systems, disasters place leader's tenure at risk because an election allows disgruntled citizens a punishing opportunity, even though preventing a natural disaster is outside the purview of officials. Flores and Smith (2012) used data from EM-DAT.

Lasala-Blanco et al. (2017), using survey data, concluded no difference in the likelihood to vote between those who had suffered greatly to those who suffered little after Hurricane Sandy struck near Brigantine, New Jersey in the 2012 presidential election. "The increase in the cost of voting . . . did not appear to be related to voting" or those in the disaster areas did not appear to use their votes to express disapproval of federal recovery efforts (Lasala-Blanco et al., 2017). This study on the prima facie evidence seems to support the voting calculus of Riker and Ordeshook (1968) concerning the costs and benefits of voting which implies under the right natural disaster events voters believe D, (see Equation (1), Page 6), motivates voters enough to ignore their circumstances and vote.

The re-election of mayor Ray Nagin after Hurricane Katrina in New Orleans shows a critical factor was the racial identity of voters who placed a greater responsibility on the federal government for their failed assistance responses (Lay, 2009). Nagin was not blamed for those failures and Lay (2009) clearly states Nagin's re-election support was "defined by race." Elections following on the heels of natural disasters provide an excellent test for retrospective voting and as Lay (2009) shows, race. Ergo, was the election about Nagin or an informal referendum of the Bush administration's bungling of the Katrina catastrophe? Lasala-Blanco et al. (2017) and Lay (2009) seem to have differing conclusions regarding the same type of disaster, hurricanes and retrospective voting regarding the federal government's response. Part of the problem is: How do governors respond to the disaster and ask for federal help? Democrat Louisiana governor Kathleen Blanco, during hurricane Katrina, was blamed for her unpreparedness and indecisiveness; however, Gasper and Reeves (2010) studied governors up for reelection during a disaster crisis and found they behave opportunistically. They did not find evidence of partisanship as governors had no issue asking for help, even in battleground states, from a president's opposing party. The Democrat Blanco asked for help from the Republican George W. Bush administration and pointed out that Mississippi Republican governor Haley Barbour received more federal aid, supporting the finding that the key is the motivations of the president and governor (Gasper and Reeves, 2010). One study did find voters punish incumbents if tornados created economic damages, but interestingly, not for the fatalities in the damaged county and surrounding counties (Healy and Malhotra, 2010). Incumbents were punished if no government response occurred.

2.1 Flooding and hurricanes

Using voter data from the Louisiana Secretary of State's Office that included individual data on all registered voters in the New Orleans parish of 238,627 individuals and US Census blockgroup information, Sinclair et al. (2011) found flooding on voter participation was not linear. However, registered voters who experienced more than 6 feet of flooding were more likely to participate in the election than those who experienced less flooding. They concluded there is a complex relationship between participation and the costs and benefits of turnout. This complexity appears in Equation (1).

Tropical storm Allison created massive flooding in Southeast Texas by raining for almost five days straight and parts of Houston received nearly 37 inches of rain in June 2001. The resulting 500-year flood caused nearly $5 billion in damages with twenty-two people losing their lives. Using survey data, Arceneaux and Stein (2006) studied the accountability question, who do voters blame for flood preparedness and found preferences for voting were determined by personal experiences and the public's ability to bring those choices to the appropriate elected officials. In this case study, the incumbent Houston mayor Lee Brown survived re-election.

Czechoslovakia suffered catastrophic floods in 2002 and had local elections the same year. Potluka and Slavikova (2010) hypothesized whether this disaster would change the political representation in the flooded towns. The finding was no statistical significant impact existed. Another flood study evaluated the counties of the Great Mississippi Flood and the 1928 Presidential election which used a differences in differences model and found the flood effects were substantial and negative which probably cost candidate Herbert Hoover 10.8% points. Heersink et al. (2017) concluded the counties with the worst flooding did not punish Hoover more but the counties with less damage did. This finding contradicts the assumption of retrospection voting that voters look backward in assessing the incumbent's performance. Another study shows that voters reward the observed aid and the action but also punish the denying of help to both POTUS and governors and the authors concluded this showed evidence for retrospective voting (Gasper and Reeves, 2011).

2.2 Earthquakes

Rissmann (2016) working paper tested an incumbent punishment hypothesis using a two level hierarchical linear regression on the electoral outcomes in earthquake disaster areas from 690 electoral districts in 16 Latin American countries for the 1980-2012 time period. The data came from EM-DAT and the DesInventar Project which geo-references down to municipality level. Rissmann (2016) found voters punish incumbents, after earthquake disasters, when good quality institutions exist. In countries with poor quality institutions incumbents do not receive punishment but are rewarded. Visconti (2018) found citizens affected by catastrophes, especially earthquakes in Chile, seek to reduce the gap between their living conditions before and after the disaster. This leads them to focus on welfare and social policies. Consequently, they are more inclined to vote for parties or persons associated with those measures because of a shift in priorities i.e., housing (Visconti, 2018). Under those conditions an incumbent may lose the election. This study used fieldwork survey data.

Anbarci et al. (2005) has a model showing per capita income and inequality relate to an earthquake's actual death toll because of existing collective action problems. The interconnectedness of per capita income and the level of inequality in the society causes the rich to self-insure against future disasters leaving the poor to fend for themselves. Within this theoretical paradigm, political-economic institutions have some responsibility for earthquake deaths (Anbarci et al., 2005). Carlin et al. (2014*a*) argues natural disasters may impact the political climate enough to add additional stresses to the political system and may lead to a potential political change and public opinion. Earthquake shocks impact on political change by causing voters to hold incumbents responsible for human and physical earthquake damages (Habibur Rahman et al., 2017).

2.3 Rain

Using 3,000 Spanish weather stations, rain and voting was studied by Artés (2014) to determine the causal effect of voter turnout in Spanish general elections. Turnout has two components; first, the weather, and second, economic conditions. Artés (2014) found the rational choice theory of voting held because bad weather increased the costs of voting and lowered the benefits of participation in the electoral process.

Rain had a negative impact on Norwegian municipal election turnout and reduces it by 0.7 percentage points and hurts left wing parties but helps right wing and local parties (Lind, 2014). Rain causes negative emotions and are a direct consequence on voter's and those negative feelings cause a less likely vote for change by 1.2 percentage points (Meier et al., 2016).

The closest comparable study to this analysis was done by Gomez et al. (2007) who also analyzed 3,114 counties in the continental United States and a time of 14 years, and 43,340 observations in an analysis of POTUS elections. The focus of the that study was precipitation and the impact upon Republican voters. This paper differs by separating the elections, House, Senate, POTUS, and governor, and uses a difference in difference model because each election has a uniqueness, i.e., different candidates and issues.

2.4 Wildfires

McCoy and Walsh (2018) based their study on Tversky and Kahneman (1974) idea of heuristics and their model drew inferences about the underlying changes in perceptions about risk regarding wildfires. Households in high risk areas may have greater sensitivity to information shocks regarding risk. Ramos and Sanz (2018) shows an accidental large fire within 9 months of a local election is Spain increases up to 8 percentage points the votes for incumbents. This is not true for regional or national elections nor for fires more than 9 months from the election.

Natural disasters are a random natural phenomena impacting every living human. Wuebbles et al. (2017) states a warming earth, according to scientific reports, will continue to degrade and the historical norm for climate will change. This brief literature natural disaster review, although *not* addressing climate change, shows natural disasters impact both negatively and positively voting behaviors and causes in varying degrees for all involved as each of us are part of the 4 billion plus people on the planet.

2.5 Minority populations and voting

In general, research has shown minority groups tend to vote less than Whites and new nationalized immigrants vote less because of language, acculturation, and socioeconomic status. Within the minority groups are naturalized citizens and Bass and Casper (2001) found that naturalized citizens who had lived in the same location for longer time periods, were older, obtained more education, and had a higher income were more likely to vote. Of course, such living conditions provide networks of social and political strength and help shape the ideology of these new Americans. Larger racial groups empirically exert a significant effect on voter turnout decisions, especially Latino and Asian American individuals and this group effect interacts with the group economic status of the group and overall county racial heterogeneity (Jang, 2009). These factors—socioeconomic status, race, education, language, and demographics—are not new to political scientists who study the inequality of representation and political participation. These elements favor those with higher wealth and income, and better education versus those who are the less advantaged citizens (Lijphart, 1997). Minority turnout is not higher in districts with minority candidates, after accounting for the relative size of the ethnic group within a district. Instead, Black and Latino citizens are more likely to vote in both primary and general elections as their share of the population increases, regardless of the candidate's race.

Although this analysis does not consider naturalized citizens the underlying finding of Bass and Casper (2001) runs through the following minority group literature.

2.5.1 Asian Americans

Xu (2002) writes that since 1990 the Asian and Pacific Islander population comprises 3.7% of the 2000 total American population. The largest of the American Asian groups are Chinese, Filipinos, Vietnamese, Koreans, Japanese, and Indians. One can easily see that Asians are not a homogenous group although they are considered as such. Many of these Americans live in California, New York, Hawaii, Texas, and Illinois. Surprisingly, Xu (2002) states that Asian Americans "experience poverty rates slightly higher than all Americans despite their higher median family incomes and educational attainment." According to Xu (2002) Asians Americans are more unlikely to register as Whites and Blacks. With lower socioeconomic status and smaller total population percentage, Asian Americans receive low returns on participation and like other minority groups opt out of the electoral process. This study examines this under natural disaster conditions. Diaz (2012) claims when Asians live in an area of more foreign born Asians and occupational clustering, Asians are less likely to vote. When Asians have higher interracial marriage rates it creates inclusiveness and increases political participation which leads to diverse social networks. Yet, in metropolitan areas Asians vote at a higher rate than Whites who are less likely to vote and this voting behavior occurs from the interconnection of employment and family income (Diaz, 2012)

(Leighley and Vedlitz, 1999) replicated the finding from earlier studies that Asian-Americans significantly participate less than Whites. However, Lien (2004) showed the usual factors used to predict Asian turnout, education, age, length state of residence, and election year, do not perform consistently across respective Asian groups. If anything, studies should not view Asians as a homogeneous group but a heterogenous population of many ethnic groups of varied backgrounds and cultures Lien (2004).

2.5.2 Black Americans

Blacks low political participation according to Milbrath and Goel (1977) comes from a low socioeconomic status because of racial characteristics. Education and income significantly affect Blacks participation rates (Harris, 1994);(Tate, 1994*a*); (Tate, 1991);(Dawson et al., 1990). Racial group consciousness plays an important role in Black political participation and has a more important role than socioeconomic status although for some such as African Caribbean, African Cuban, and Haitian Americans socioeconomics plays a greater influence (Austin et al., 2012). African Americans, African Caribbeans, African Cubans and Haitian Americans do have the traditional factors—age, gender, generation of citizenship, partisanship, and church attendance—and these have influence as well. The history of natural disasters and Blacks is chronicled in Rivera and Miller (2007) which details how natural disasters have caused Blacks to experience federal government indifference, neglect, and lack of support after disasters.

2.5.3 Hispanic Americans

Hispanic's socioeconomic and demographic variables, i.e., age, income, and education explain Hispanic nonvoting (Antunes and Gaitz, 1975; DeSipio, 1998). Socioeconomic status was also found to play a part when compared to Whites in the study by (Highton and Burris, 2002). This study also found socioeconomic status that controlled the gap between Cuban Americans, Mexican Americans, and Puerto Ricans has largely disappeared. Highton and Burris (2002) concluded that there does remain substantial intragroup variation among Hispanics. This natural disaster study does not differentiate between the different Hispanic groups. Hispanic citizens vote the same as those in the same socioeconomic status but they do vote at a lower rate, 10% less than Whites in the midterm elections (Cassel, 2002). Yet, Black and Hispanics are more likely to vote in both primary and general elections as their percentage of the population increases (Fraga, 2016).

2.5.4 Native Americans

American Indians as a minority group in eastern Oklahoma exhibit political attitudes similar to that of other US minority groups and is explained by similar socioeconomic status (Min and Savage, 2012). Minorities act as the remaining source of Democratic Party strength in the south and Eastern Oklahoma is unique because they play this role, rather than Blacks or Hispanics (Min and Savage, 2012). Skopek and Garner (2014) uses American National Election Survey data and found since 1990 Natives have become more politically involved and are closing the gap between themselves and other groups.

Because of the sordid history between the US federal and state governments one would expect Native Americans to show no or little interest in the political process. In a new study, it was found that Native Americans are no different in their involvement with voting. They do vote less than African Americans and Whites, but at similar numbers to Hispanics and Asians (Herrick et al., 2020). The study concluded, by looking at voter turnout, that there was little to support a hypothesis that Natives were unique in their voting behavior.

Although the 2010 Census shows Natives are 1.7% of the total US population in three states, they are a large enough population to affect elections, e.g., Alaska has 19.5% and Oklahoma has 12.9%, and New Mexico with 10.7% Native populations. Alaska is not part of this study but Oklahoma and New Mexico are and both have recurring natural disasters.

2.6 Emergency Events Database (EM-DAT)

The dataset, Emergency Events Database (EM-DAT) is from the Centre for Research on the Epidemiology of Disasters (CRED) and supported by Université catholique de Louvain in Brussels, Belgium. EM-DAT has twelve international collaborations and partnerships that partially includes the Max Planck Institute of Biogeochemistry, International Federation of Red Cross and Red Crescent Societies, Secretariat for the International Strategy for Disaster Reduction, United States Agency for International Development, Asian Disaster Reduction Center, and the United Nations Development Programme. EM-DAT is considered the international standard for national disaster data and this study uses only EM-DAT data for the United States.

EM-DAT classifications are adapted and based on the "Peril Classification and Hazard Glossary" from Integrated Research on Disaster Risk (2014). This programme started in 2008 with the backing from the International Council for Science, the International Social Science Council and the United Nations International Strategy for Disaster Reduction. Integrated Research on Disaster Risk strives to reduce the database gaps in disaster data collection by standardizing event classifications so database comparisons compare (Integrated Research on Disaster Risk, 2014).

A challenge to classification is the association between perils and main events, because they are not necessarily the same. IRDR recognizes that classification of disasters have great importance and such classification happens on a case-by-case basis. Perils range from ash fall, coastal erosion, flash flood, forest fire, heat wave and lightning. Disaster classification moves in two directions: the most generalized (family) to the specific (peril), and vice versa. Ergo, classifications are more pragmatic in nature than scientific (Integrated Research on Disaster Risk, 2014). "Landslides following earthquakes or volcanic eruptions fall into the geophysical main events category, whereas perils such as debris or mud flows fall under hydrological hazards" (Integrated Research on Disaster Risk, 2014). The IRDR quote shows the issues with classifications of disaster events and demonstrates the similarities and differences between perils and main events and the need for consideration of an individual disaster basis. For example, a snow avalanche may have two different causes. If an earthquake triggers the event it becomes a mass movement/geophysical event but if it starts from the snow's weight and/or the snow's instability it becomes defined as a landslide/hydrological event (Integrated Research on Disaster Risk, 2014).

EM-DAT categorizes natural disasters with six subgroups, following the categorization schema of IRDR, however this study only focuses on four: climatological, geophysical, hydrological, and meteorological. The two categories biological and extraterrestrial are not included in this research. Only five biological and zero extraterrestrial events occurred in this study's timeframe of 1990-2016. Table 2, shows how EM-DAT categorizes and defines a natural disaster for the four disaster subgroups. This study follows this categorization and definition format throughout the analysis.

Table 2: EM-DAT natural disaster group subgroups and definitions

Disaster Subgroup	Definition
Climatological	A hazard caused by long-lived, meso- to macro-scale atmospheric processes ranging from intra-seasonal to multi-decadal climate variability.
Geophysical	A hazard originating from solid earth. This term is used interchangeably with the term geological hazard.
Hydrological	A hazard caused by the occurrence, movement, and distribution of surface and subsurface freshwater and saltwater.
Meteorological	A hazard caused by short-lived, micro- to meso-scale extreme weather and atmospheric conditions that last from minutes to days.

The definitional difference between climatological and meteorological is time. Climatological measures years and meteorological has a short time duration lasting from minutes to days. These EM-DAT definitions are the same as IRDR except IRDR uses the heading "family" and EM-DAT uses "natural" as shown in the caption title of Table 2.

Table 3 and Table 4 illustrates the frequencies and years of climatological disasters.

Table 3: Climatological state frequency for 1990-2016

State	STFIPS	Freq.	Percent
California	6	9	75.00
New Mexico	35	1	8.33
Texas	48	1	8.33
Washington	53	1	8.33
Total		12	100.00

Table 4: Climatological frequency for 1990-2016

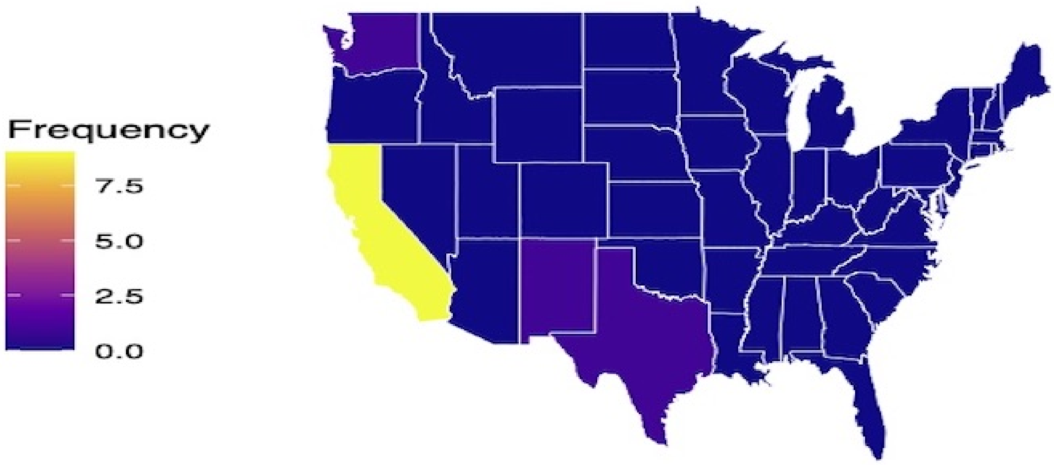
Year	Freq.	Percent
1994	1	8.33
1998	1	8.33
2000	1	8.33
2002	3	25.00
2003	1	8.33
2006	2	16.67
2014	3	25.00

Continued on next page

Table 4 – continued from previous page

State	STFIPS	Freq.
Total	12	100.00

Figure 1: Climatological frequency for 1990-2016



Texas only has one climatological disaster in this study the same as NM, and WA. California leads the nation in EM-DAT climatological disasters and the years 2002 and 2014 had the most frequent climatological events. These states, California, New Mexico, Texas, and Washington, have an approximate mean of 20% of the population classified as minority races. Because the higher minority population in these states disasters may play a more key role in the minority voting turnout.

Table 5: Geophysical state frequency for 1990-2016

State	STFIPS	Freq.	Percent
California	6	19	95.00
Hawaii	15	1	5.00
Total		20	100.00

Table 6: Geophysical frequency for 1990-2016

Year	Freq.	Percent
1990	10	50.00
1994	4	20.00
2006	1	5.00

Continued on next page

Year	Freq.	Percent
2010	1	5.00
2014	4	20.00
Total	20	100.00

Table 6 – continued from previous page

Tables 5 to 6 shows only two states qualify for EM-DAT geophysical disasters, California and Hawaii and 1990 had the most geophysical events according to EM-DAT for the period 1990-2016. Hawaii does not appear in Figure 2.

Figure 2: Geophysical frequency for 1990-2016

Table 7: Hydrological state frequency for 1990-2016

State	STFIPS	Freq.	Percent
Alabama	1	2	4.26
Arkansas	5	4	8.51
California	6	8	17.02
Georgia	13	6	12.77
Hawaii	15	1	2.13
Louisiana	22	1	2.13
Missouri	29	3	6.38
New Jersey	34	4	8.51
North Dakota	38	2	4.26
Ohio	39	7	14.89
Tennessee	47	1	2.13
Texas	48	8	17.02
Total		47	100.00

Table 8: Hydrological frequency for 1990-2016

Year	**Freq.**	**Percent**
1990	1	2.13
1994	3	6.38
1995	1	2.13
1998	8	17.02
2000	3	6.38
2002	5	10.64
2004	2	4.26
2005	4	8.51
2006	20	42.55
Total	47	100.00

EM-DAT hydrological disasters occurred the most in California and Texas and the year with the highest count of events was 2006 according to Tables 7 to 8.

Figure 3: Hydrological frequency for 1990-2016

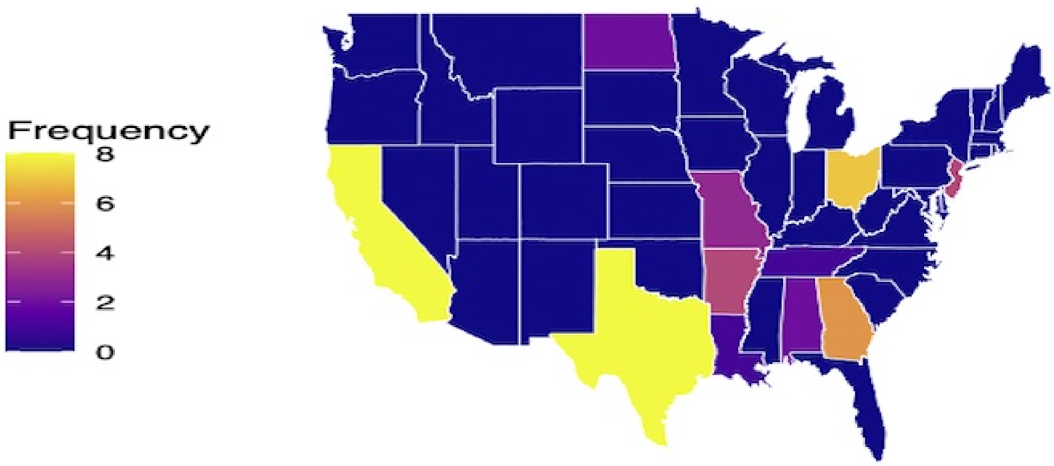


Table 9: Meteorological frequency and states for 1990-2016

State	**STFIPS**	**Freq.**	**Percent**
Colorado	8	1	0.55
Florida	12	3	1.66
Georgia	13	1	0.55
Illinois	17	9	4.97
Indiana	18	17	9.39
Kansas	20	1	0.55
Kentucky	21	12	6.63

Continued on next page

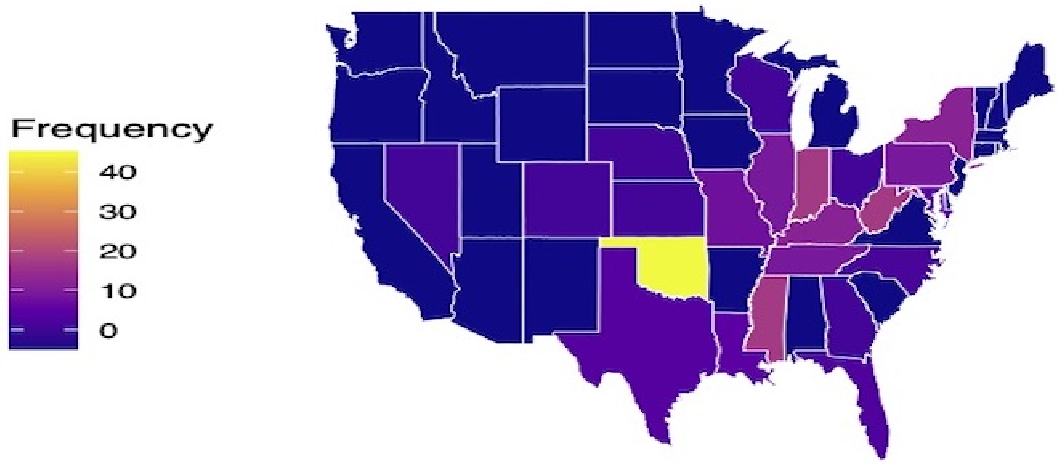
Table 9 – continued from previous page			
State	**STFIPS**	**Freq.**	**Percent**
Louisiana	22	5	2.76
Maryland	24	5	2.76
Mississippi	28	17	9.39
Missouri	29	8	4.42
Nebraska	31	1	0.55
Nevada	32	1	0.55
New York	36	12	6.63
North Carolina	37	2	1.10
Ohio	39	1	0.55
Oklahoma	40	45	24.86
Pennsylvania	42	9	4.97
Tennessee	47	9	4.97
Texas	48	4	2.21
West Virginia	54	17	9.39
Wisconsin	55	1	0.55
Total		181	100.00

Table 10: Meteorolgical frequency for 1990-2016

1994	1	0.55
1998	4	2.21
2002	89	49.17
2003	34	18.78
2004	42	23.20
2006	8	4.42
2014	1	0.55
2016	2	1.10
Total	181	100.00

Meteorological disasters are by far the most frequent event according to Tables 9 to 10 with Oklahoma having 24.86% of the nation's meteorological events. 2002 had the most EM-DAT recognized disasters.

Figure 4: Meteorological frequency for 1990-2016



The purpose for investigating the descriptive subgroup statistics serves two purposes. First, it allows one to grasp the statistical saliency of disaster research and the problems associated with classification and categorization of events to have meaningful statistics. Second, this investigation allows for a visual representation for yearly comparisons and the exposure to historical natural disasters events.

2.7 What qualifies as a disaster?

According to EM-DATA, disasters must meet at *least one* of the criteria below to classify as a disaster (catholique de Louvain, 2019).

- 10 or more people dead
- 100 or more people affected
- The declaration of a state of emergency
- A call for international assistance

The US government generally does not ask for international aid in times of disasters so to qualify as an EM-DAT disaster the US must meet one of the first three benchmarks: 10 or more deaths, 100 or more affected, and the declaration of a state of emergency. Notice, none of these requirements involve damage monetary amounts. This study uses EM-DAT requirements but only of election years.

The study of natural disasters has unique problems because of measurement and classification issues. Yet, natural disasters impact every human on Earth either directly or indirectly. This research attempts to further examine the impact of natural disasters on the participation of citizens in the voluntary political process of voting.

3 Empirical approach

This chapter discusses the methodology used for this study in explaining the method used to determine the effect natural disasters has on voting behavior. Natural disasters may cause citizens to punish leadership in elections if they believe the government bears responsibility for their suffering (Abney and Hill, 1966; Achen and Bartels, 2017; Arceneaux and Stein, 2006; Rissmann, 2016; Ashworth et al., 2018). Achen and Bartels (2017) states, "The argument that natural disasters threaten rulers and regimes is not new. However, the base of evidence on which it rests, while impressively broad historically, is also uncomfortably thin." The studies listed above have mixed results from the causation of natural disasters on election results. The theory these scholars use for the studies is retrospective voting, or voters reward or punish by the incumbent's impact on the individual. Such voting behavior is not always viewed as rational behavior, however to the individual voter the behavior has rationality.

The method in this study views voting behavior from a different perspective. Rather than punishing or rewarding incumbents and candidates, voters may decide, especially after a natural disaster, that a prohibitive cost of voting does not align with their preferences and choose not to participate in the election process. Such behavior shows in a lower total vote counts and a rational response to the individual voter's preferences as discussed in Section 1.2.

The above studies usually follow a similar methodology format: survey data (Arceneaux and Stein, 2006; Lasala-Blanco et al., 2017); polling data (Lay, 2009); voting turnout (Sinclair et al., 2011); and regression analysis (Potluka and Slavikova, 2010). Achen and Bartels (2004, 2017), Potluka and Slavikova (2010) and Gasper and Reeves (2011) use ordinary least squares regression analyses using similar variables in their studies. This study will use regression analysis similar to those in Achen and Bartels (2004, 2017); duPont IV and Noy (2015); Cavallo and Noy (2009); Coffman and Noy (2012) using differences in difference modeling, also known as synthetic controls.

The dependent variable y_{it} represents the aggregate of voter participation at location i at time t_0 the time before the disaster. *Ex ante* natural disaster is represented as t_{-1}.

Mathematically the change in y_{it} is calculated as:

$$\text{Change in voting participation} = \Delta y_{it} = y_{it=0} - y_{i,t-1} \tag{10}$$

Δy_{it} represents the change in the number of total voting participants i represents the location, in this model individual counties (FIPS), and t is time. This change in the number of total votes simulates the cost of voting after a disaster as in the discussion of Riker and Ordeshook (1968) in Section 1.2.

The dependent variable $y1$ is defined as $y1 = \frac{\text{election total votes}}{\text{potential population}}$. Potential population (potpop) sums the total population for the following: Asians, Blacks, Hispanics, Native, Two or more (self-identified people of Two or more races as defined by the US Census Bureau), and Whites for the ages of 20 year-old and upwards. The US Census Bureau age categories, relative to this study, must start at 20 years-old and older even though the voting age in the US is 18. The Census has a category for 15-19 years-old and 20-24 years-old and the study could not determine who was age 18 and older in aggregate data.

From 10 we have the following linear equation model.

$$\Delta y_{it} = y1 = \alpha + \beta \mathbf{X}_{it} + \gamma DIS_{it} + \epsilon_i \tag{11}$$

$\beta \mathbf{X}$ is the combination of independent variables related to the election, e.g., location, year, and voter race. DIS represents the specific disaster variable related to disaster subgroup is classified as a dummy variable where DIS equals one for a disaster in the year of an election and zero otherwise. Each regression only considers one of the four natural disaster subgroups and election races. Disaster categories are not mixed in the equation and neither are elections. For example, disasters are classified separately so combinations do not exist between the the four disaster subgroups creating an aggregate regression. The same exists for elections even when the four elections—House, Senate, gubernatorial, and POTUS—may occur in the same year. ϵ symbolize the errors. i indexes locations and t years with $y1$ as the dependent variable In Equation (11) as defined in Equation (10). This creates the following theoretical equation.

$$Y_{it} = \beta_1 + \beta_2(treat_i) + \beta_3(time_t) + \rho(treat_i \times time_t) + \epsilon_{it} \tag{12}$$

Equation (12), a Difference in Differences equation, is a tool used to estimate treatment effects comparing the pre- and post-treatment differences in the outcome of a treatment and a control group. In this study, the pre- and post-treatment differences test the outcome of the impact natural disasters have upon racial minority groups voting turnout by attempting to estimate the effect of a treatment or the disaster event's as represented by by the DV, Y_{it}.

Equation (12) transforms into the following working model of Equation (13).

$$y1 = \alpha + \beta_1\text{disaster} + \beta_2\text{race} + \beta_3(\text{disaster } \times\text{race}) + \beta_4\text{election data} + \beta_5\text{individual year} + \epsilon \tag{13}$$

Equation (13) becomes the foundational equation for this study.

3.1 Glossary

The variables used in the regression analysis are defined and listed in Table 11. This glossary provides how the variable was created and the variable's definition.

Table 11: Variable label and definition glossary

Variable	**Label**	**Definition**
y1	$\text{y1} = \frac{\text{election total votes}}{\text{potential population}}$	dependent variable
asianper	$\text{asianper} = \frac{\text{total Asian}}{\text{potential population}}$	percent of Asian population in county
blackper	$\text{blackper} = \frac{\text{total Blacks}}{\text{potential population}}$	percentage of total Blacks in county population
climate	climatological disasters	One of the four EM-DAT recognized subgroup disasters
FIPS	county FIPS	Federal government five-digit number designation primarily for counties, Louisiana parishes, certain metropolitan areas.
g1	created governor variable	variable created to assist in the analysis and prevent repeated time issues in the regression

Continued on next page

Table 11 – continued from previous page

Variable	Label	Definition
geo	geophysical disasters	One of the four EM-DAT recognized subgroup disasters.
hispper	hispper = $\frac{\text{total Hispanics}}{\text{potential population}}$	percentage of total Hispanics in county population
demper	hdemper = $\frac{\text{hdemvote}}{\text{htotal}}$	Democrat vote percent in total county votes
margin	vote margin = htotal X hmarper	Democract vote margin in total county votes
hydro	hydrological disasters	One of the four EM-DAT recognized subgroup disasters.
STFIPS	state FIPS	Federal government two-digit designation for states and Washington DC.
meteor	meteorological disasters	One of the four EM-DAT recognized subgroup disasters
nativeper	nativeper = $\frac{\text{total Native Americans}}{\text{potential population}}$	percent of total Native Americans in the county population
twoper	twoper = $\frac{\text{total Two or more races}}{\text{potential population}}$	percent total of people self-identifying by the US Census Bureau as Two or more races
potpop	county potential total population	potpop sums the total population for the races in the study plus Whites for the ages of 20 years and older

Table 12 lists the most used *prefixes* for the variables in the dataset along with the definition for the prefix. For example, gmargin represents the governor democrat vote margin of the county (FIPS), and STFIPS stands for the state FIPS code.

Table 12: Variable prefix definitions

Variable	Definition
c	climatological disaster
g	geophysical disaster
h	hydrological disaster
i	interaction variable
m	meteorological disaster
g	governor election
h	house election
s	senate election
p	presidential election
st	state

3.2 Assumptions and explanations

This study makes the following assumptions and explanations.

- Alaska is not included in this study because the state has 19 boroughs and one unorganized borough. The borough boundaries change with every census and this changing boundary because of population changes for state legislature representation makes comparisons impossible. Because of the changing boundaries, and most boroughs are sparsely populated and uninhabited it seemed prudent to drop Alaska from the study.

- All of the races in the regression analysis was compared to Whites, the majority race in the United States. The analysis assumed Whites would vote regardless of a natural disaster or not. To eliminate collinearity issues in the analysis by using all of the races and ethnicities the Whites were dropped.

- Each state has its own unique FIPS code assigned to it by the US government. County FIPS codes are also unique but are combined with the state FIPS codes resulting in a final code. Garfield county, CO has a different FIPS code, (08045), than Garfield county, WA (53023) because Colorado and Washington have unique state codes even though the county name is the same. To read a county FIPS code the first two numbers are the state, Colorado is 08 and Washington 53, and the last three numbers the county code, 045 for Garfield county, CO.

- The US Census Bureau changed the race and ethnicity data categorization in the 2000 census and Table 13 shows the coding used by the Census Bureau for 1990-99.

Table 13: 1990-99 race-sex code

No.	Definition
1	White male
2	White female
3	Black male
4	Black female
5	American Indian or Alaska Native male

Continued on next page

Table 13 – continued from previous page

No.	Definition
6	American Indian or Alaska Native female
7	Asian or Pacific Islander male
8	Asian or Pacific Islander female

Table 13 does not have a separate category for Hispanics. The US Bureau of the Census (2003), instead of a separate category used a separate ethnic origin code of 1= not Hispanic or Latino and 2=Hispanic or Latino. For example, a Black female citizen would indicate 4 and either 1 or 2 for Hispanic ethnicity. For the 2000 census a change was made in the categorizations of race and ethnicity US Bureau of the Census (2012). Table 14 lists the new codes used by the Census Bureau. The 2000 census eliminated the additional 1 or 2 for Hispanic ethnicity and had separate codes for the inclusion of race and those with Hispanic ethnicity.

Table 14: 2000-16 US Census Race and Hispanic origin

Variable	Description
TOT_POP	Total population
TOT_MALE	Total male population
TOT_FEMALE	Total female population
WA_MALE	White alone male population
WA_FEMALE	White alone female population
BA_MALE	Black or African American alone male population
BA_FEMALE	Black or African American alone female population
IA_ MALE	American Indian and Alaska Native alone male population
IA_ FEMALE	American Indian and Alaska Native alone female population
AA_MALE	Asian alone male population
AA_FEMALE	Asian alone female population
NA_MALE	Native Hawaiian and Other Pacific Islander alone male population
NA_FEMALE	Native Hawaiian and Other Pacific Islander alone female population
TOM_MALE	Two or More Races male population
TOM_FEMALE	Two or More Races female population
NH_MALE	Not Hispanic male population
NH_FEMALE	Not Hispanic female population
NHWA_MALE	Not Hispanic, White alone male population
NHWA_FEMALE	Not Hispanic, White alone female population
NHBA_MALE	Not Hispanic, Black or African American alone male population

Continued on next page

Table 14 – continued from previous page

Variable	Description
NHBA_FEMALE	Not Hispanic, Black or African American alone female population
NHIA_MALE	Not Hispanic, American Indian and Alaska Native alone male population
NHIA_FEMALE	Not Hispanic, American Indian and Alaska Native alone female population
NHAA_MALE	Not Hispanic, Asian alone male population
NHAA_FEMALE	Not Hispanic, Asian alone female population
NHNA_MALE	Not Hispanic, Native Hawaiian and Other Pacific Islander alone male population
NHNA_FEMALE	Not Hispanic, Native Hawaiian and Other Pacific Islander alone female population
NHTOM_MALE	Not Hispanic, Two or More Races male population
NHTOM_FEMALE	Not Hispanic, Two or More Races female population
H_MALE	Hispanic male population
H_FEMALE	Hispanic female population
HWA_MALE	Hispanic, White alone male population
HWA_FEMALE	Hispanic, White alone female population
HBA_MALE	Hispanic, Black or African American alone male population
HBA_FEMALE	Hispanic, Black or African American alone female population
HIA_MALE	Hispanic, American Indian and Alaska Native alone male population
HIA_FEMALE	Hispanic, American Indian and Alaska Native alone female population
HAA_MALE	Hispanic, Asian alone male population
HAA_FEMALE	Hispanic, Asian alone female population
HNA_MALE	Hispanic, Native Hawaiian and Other Pacific Islander alone male population
HNA_FEMALE	Hispanic, Native Hawaiian and Other Pacific Islander alone female population
HTOM_MALE	Hispanic, Two or More Races male population
HTOME_FEMALE	Hispanic, Two or More Races female population

This study views Hispanics as equal to Asian, Black, Native American, Two or more race, and White races. However, the Census Bureau considers Hispanics an ethnic group. This study's groupings of the races and Hispanics does not change the outcomes because Hispanics are studied as a race as the literature in Section 2.5.3 shows. Thus, the regression variables for race are Asian percentage (asianper), Black percentage (blackper), Hispanic percentage (hispper), Native American percentage (nativeper), and Two or more races (twoper). These percentages are the sum of the males and females of the particular race and ethnicity in the FIPS (county). Dividing the total ethnic race group by the potential population gives the FIPS percentage. The potential population, the DV denominator, is defined in Table 11, Page 30.

3.3 Data

The data for this study comes from three primary sources. The US Census Bureau provided the county population and race data. Type of disaster, year of event, and location of the disaster comes from EM-DAT while *Dave Leip's Atlas of US Presidential Elections* records the voting results for the four elections used in this study. These three data sets were merged into one data set for each type of election.

3.4 Governor election analysis

All of the models in the governor analysis compare the election turnout to Whites as these models focuses upon Asians, Blacks, Hispanics, Natives, and Two races or more as categorized by the US Census Bureau.

Table 15 displays all of the disaster and governor elections for the years in the analysis. Frequency is the number of counties in that year's election. This study uses three models per each disaster category with some variation from the models used by the House, POTUS, and Senate elections. The major difference with the governor analysis is the use of STFIPS instead of clustering FIPS and a dummy variable for the varying seasonality of governor elections. In the other three elections—House, POTUS, and Senate—the regression used the FIPS cluster option.

With governor races, clustering STFIPS created repeated time value problems. To overcome this problem the governor regressions used the individual states (STFIPS) in the regressions. Gubernatorial elections occur every year and the pattern that emerges shows more readily in the percent column of Table 15 as 9.77, 1.21, 2.60, and 0.71. These percentage numbers repeat every four years, within a hundredth of a point from year to year. To compensate for this a dummy variable, g1, was created. Years 1990, 1994, 1998, 2002, 2006, 2010, and 2014 had a code of g1=1. 1991, 1995, 1999, 2003, 2007, 2011, and 2015 had the code of g1=2. g1=3 represents 1992, 1996, 2000, 2004, 2008, 2012, and 2016. 1993, 1997, 2001, 2005, 2009, and 2013 are g1=4. Coding the g1 in this manner allowed the regression to provide results however, g1 was dropped for collinearity leaving only g2, g3, and g4.

Table 15: Governor election cycle

Year	**Freq**	**Percent**	**Cum**	**g1**
1990	2148	9.77	9.77	1
1991	266	1.21	10.98	2
1992	571	2.60	13.58	3
1993	156	0.71	14.29	4
1994	2148	9.77	24.07	1
1995	266	1.21	25.28	2
1996	566	2.58	27.85	3

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Table 15 – continued from previous page

	Freq	Per	Cum	g1
1997	156	0.71	28.56	4
1998	2148	9.77	38.34	1
1999	266	1.21	39.55	2
2000	566	2.58	42.12	3
2001	155	0.71	42.83	4
2002	2149	9.78	52.60	1
2003	324	1.47	54.08	2
2004	566	2.58	56.65	3
2005	155	0.71	57.36	4
2006	2149	9.78	67.14	1
2007	266	1.21	68.35	2
2008	566	2.58	70.92	3
2009	155	0.71	71.63	4
2010	2178	9.91	81.54	1
2011	321	1.46	83.00	2
2012	566	2.58	85.58	3
2013	154	0.70	86.28	4
2014	2148	9.77	96.05	1
2015	266	1.21	97.26	2
2016	602	2.74	100.00	3
Total	21977	100.00		

Models 1, 4, 7, and 10 use Equation (14). β_1 is a disaster dummy variable coded $\beta_1 = 1$ if the disaster occurred and $\beta_1 = 0$ otherwise. The purpose of Equation (14) determines if disasters have any impact at all on the individual races and ethnicities and is the most basic format. Equation (14) has an underlying assumption that disasters do not affect minority voter turnout.

$$y1 = \alpha + \beta_1 \text{disaster} + \beta_2 \text{race} + \beta_3 \text{individual year} + \beta_4 \text{STFIPS} + \epsilon \tag{14}$$

Models 2, 5, 8, and 11 follow the follow format of Equation (14) but includes an interaction variable between the disaster and the races and tests the assumption that natural disasters do impact the individual minority groups.

$$y1 = \alpha + \beta_1 \text{disaster} + \beta_2 \text{race} + \beta_3 (\text{disaster X race}) + \beta_4 (\text{individual year}) + \beta_5 \text{STFIPS} + \epsilon \tag{15}$$

Models 3, 6, 9, and 12 include the format of Equation (15) with the addition of the election data and results in Equation (16). The election data variables are the margin of winning vote percentage and the Democrat party percentage of the total votes. The winning vote percentage does not differentiate between parties or candidates, just what the winning percentage was of the total votes cast. The two reasons why it does not matter if this study used the Democratic party or Republican party as independent variables: First, because if both variables were in the regression one would have been dropped because of collinearity and second, because the US has two major parties, Democrats and Republicans, and a win or loss by one party is the inverse of the other at election time.

$$\begin{aligned} y1 = \alpha + \beta_1 \text{disaster} + \beta_2 \text{election data} + \beta_3 \text{race} + \beta_4 (\text{disaster } \times \text{race}) \\ + \beta_5 \text{individual year} + \beta \text{STFIPS} + \epsilon \end{aligned} \tag{16}$$

All of the four major disasters are dummy variables and are coded 1 equals a disaster and 0 equals otherwise or no disaster. The calculation for the DV is $y1 = \frac{gtotal}{pottot}$ where gtotal represents the governor race total election votes and the denominator represents the sum of the potential total voters in the county. All of the DVs follow the same format with the only change in the numerator for each elected office total votes. The denominator never changes. The governor regression results follow in Table 16.

Table 16: Governor disaster regression results
DV vote turnout

	Climatological			Geophysical			Hydrological			Meteorlogical		
VARIABLES	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
climatological	-0.0481***	0.0901**	0.0915***									
	(0.0125)	(0.0369)	(0.0350)									
margin win			2.67e-08			2.32e-08			2.21e-08			2.18e-08
			(4.72e-08)			(4.78e-08)			(4.74e-08)			(4.74e-08)
gov dem%			0.0400***			0.0399***			0.0399***			0.0404***
			(0.00651)			(0.00651)			(0.00652)			(0.00651)
asian %	-0.599***	-0.599***	-0.647***	-0.601***	-0.607***	-0.653***	-0.602***	-0.604***	-0.650***	-0.602***	-0.599***	-0.645***
	(0.0753)	(0.0755)	(0.0800)	(0.0758)	(0.0754)	(0.0802)	(0.0758)	(0.0760)	(0.0806)	(0.0758)	(0.0755)	(0.0802)
black %	-0.0532***	-0.0532***	-0.0739***	-0.0532***	-0.0530***	-0.0736***	-0.0532***	-0.0532***	-0.0738***	-0.0532***	-0.0526***	-0.0734***
	(0.0142)	(0.0142)	(0.0146)	(0.0142)	(0.0142)	(0.0146)	(0.0142)	(0.0142)	(0.0146)	(0.0142)	(0.0142)	(0.0145)
hispanic %	-0.266***	-0.266***	-0.277***	-0.266***	-0.266***	-0.277***	-0.267***	-0.266***	-0.277***	-0.267***	-0.266***	-0.277***
	(0.0217)	(0.0217)	(0.0212)	(0.0217)	(0.0217)	(0.0212)	(0.0217)	(0.0218)	(0.0212)	(0.0217)	(0.0217)	(0.0212)
native %	-0.243***	-0.243***	-0.257***	-0.243***	-0.243***	-0.257***	-0.243***	-0.243***	-0.257***	-0.243***	-0.242***	-0.256***
	(0.0257)	(0.0257)	(0.0259)	(0.0257)	(0.0257)	(0.0259)	(0.0257)	(0.0257)	(0.0259)	(0.0257)	(0.0257)	(0.0259)
two %	-1.530***	-1.530***	-1.617***	-1.527***	-1.536***	-1.622***	-1.531***	-1.534***	-1.621***	-1.531***	-1.556***	-1.645***
	(0.164)	(0.164)	(0.168)	(0.165)	(0.167)	(0.171)	(0.164)	(0.165)	(0.168)	(0.164)	(0.166)	(0.169)
1.climate#c.asian %		-0.0554	-0.127									
		(0.210)	(0.213)									
1.climate#c.black %		1.238**	1.377**									
		(0.552)	(0.545)									
1.climate#c.hispanic %		-0.649***	-0.669***									
		(0.152)	(0.147)									
1.climate#c.native %		-4.664**	-4.530**									
		(2.140)	(2.128)									
1.climate#c.two %		0.956	1.220									
		(0.982)	(0.962)									
geophysical				-0.0302**	-0.0386	-0.0381						
				(0.0124)	(0.0238)	(0.0234)						
1.geo#c.asian %					0.592***	0.557***						
					(0.151)	(0.156)						
1.geo#c.black %					-0.418*	-0.390*						
					(0.232)	(0.217)						
1.geo#c.hispanic %					-0.143***	-0.132***						
					(0.0486)	(0.0484)						
1.geo#c.native %					2.357***	2.102***						
					(0.604)	(0.591)						
1.geo#c.two %					-0.947***	-0.868**						
					(0.352)	(0.352)						
hydrological							0.00396	0.0415***	0.0356***			
							(0.00737)	(0.0140)	(0.0138)			
1.hydro#c.asian %								0.117	0.172			

Continued on next page

Table 16 – continued from previous page

	Climatological			Geophysical			Hydrological			Meteorlogical		
VARIABLES	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
								(0.169)	(0.168)			
1.hydro#c.black %								-0.0371	-0.0452			
								(0.0523)	(0.0533)			
1.hydro#c.hispanic %								-0.0908*	-0.0795*			
								(0.0485)	(0.0462)			
1.hydro#c.native %								-6.386***	-5.546**			
								(2.297)	(2.275)			
1.hydro#c.two %								-0.132	-0.232			
								(0.541)	(0.545)			
meteorological										0.00523	0.0111	0.00916
										(0.00447)	(0.00676)	(0.00674)
1.meteor#c.asian %											-0.976**	-0.892*
											(0.476)	(0.488)
1.meteor#c.black %											-0.148***	-0.153***
											(0.0468)	(0.0465)
1.meteor#c.hispanic %											-0.116*	-0.107*
											(0.0598)	(0.0606)
1.meteor#c.native %											-0.361*	-0.394*
											(0.205)	(0.215)
1.meteor#c.two %											2.415***	2.594***
											(0.555)	(0.578)
2.g1	-0.0957***	-0.0955***	-0.0841***	-0.0966***	-0.0966***	-0.0851***	-0.0956***	-0.0959***	-0.0843***	-0.0952***	-0.0963***	-0.0849***
	(0.00598)	(0.00602)	(0.00639)	(0.00596)	(0.00596)	(0.00634)	(0.00596)	(0.00597)	(0.00636)	(0.00598)	(0.00601)	(0.00638)
3.g1	0.196***	0.196***	0.205***	0.196***	0.196***	0.205***	0.196***	0.196***	0.205***	0.196***	0.196***	0.205***
	(0.00673)	(0.00673)	(0.00685)	(0.00673)	(0.00674)	(0.00685)	(0.00673)	(0.00673)	(0.00685)	(0.00673)	(0.00673)	(0.00685)
4.g1	-0.0410***	-0.0410***	-0.0332***	-0.0412***	-0.0410***	-0.0332***	-0.0410***	-0.0408***	-0.0330***	-0.0410***	-0.0408***	-0.0329***
	(0.0108)	(0.0108)	(0.0108)	(0.0108)	(0.0108)	(0.0108)	(0.0108)	(0.0108)	(0.0108)	(0.0108)	(0.0107)	(0.0108)
year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
state FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Constant	0.453***	0.453***	0.435***	0.453***	0.453***	0.435***	0.453***	0.453***	0.435***	0.453***	0.452***	0.434***
	(0.00851)	(0.00851)	(0.00883)	(0.00851)	(0.00851)	(0.00883)	(0.00851)	(0.00851)	(0.00883)	(0.00851)	(0.00850)	(0.00882)
Observations	21,977	21,977	21,977	21,977	21,977	21,977	21,977	21,977	21,977	21,977	21,977	21,977
R-squared	0.654	0.654	0.655	0.654	0.654	0.655	0.654	0.654	0.655	0.654	0.654	0.655

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

3.4.1 Climatological analysis

In all three climatological regressions models the climate variable is statistically significant but when not interacted with racial groups, then climatological is negatively statistically significant. With interaction with the racial groups climate becomes positive statistically significant. Without an interaction between climate and ethnicity as in Model 1, each of the five racial groups in this study vote relatively less than Whites in terms of the population percentage. This finding supports the assumption that Whites, as the majority race in the US, will vote in the governor's election regardless of a climate natural disaster or not.

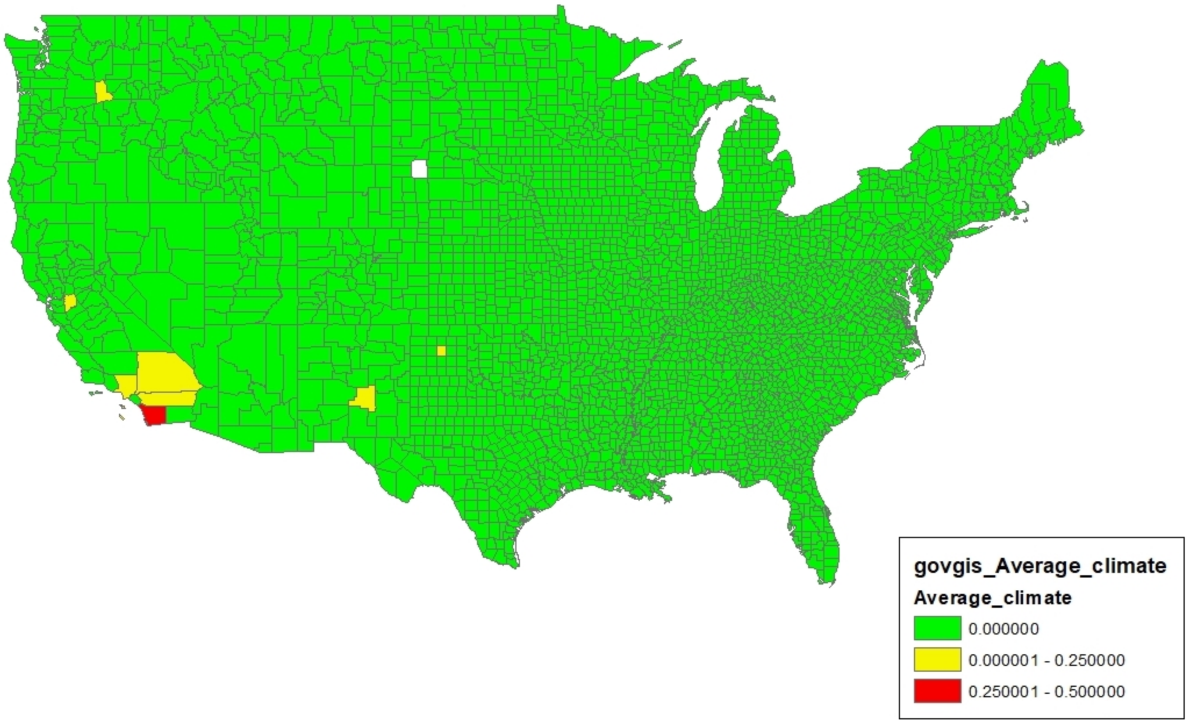
Model 1 suggests a climate disaster would impact a lower governor total vote assuming voters possibly disagree with an incumbent governor's climatological disaster policies. This supports the work by Arceneaux and Stein (2006) who found if the voter thinks the government could prevent the intensity of the catastrophe but Lasala-Blanco et al. (2017) seems to contradict Arceneaux and Stein (2006) findings. Because the EM-DAT definition for a climatological disaster specifies a "hazard caused by... atmospheric processes ranging from intraseasonal to multi-decadal climate variability" this disaster category is of long-duration and possibly the disaster has little to do with election turnout. Model 1 does support the Lijphart (1997) hypothesis that minority groups do not vote when compared to Whites.

In both models 2 and 3 the same pattern occurs. Both of these models have climatological interaction with the races. Blacks tend to to vote statistically more than Whites in terms of total population percentages in models 2 and 3, and Hispanics and Natives statistically significantly tend to vote less than Whites in terms of total population percentage.

The election variables in model 3, margin of winning votes is not significant while the governor's Democratic percentage of votes is highly significant. This shows that accounting for climate and interaction between climate and race and ethnicity there is a positive affect in the increase of Democratic votes to the total percentage of governor votes.

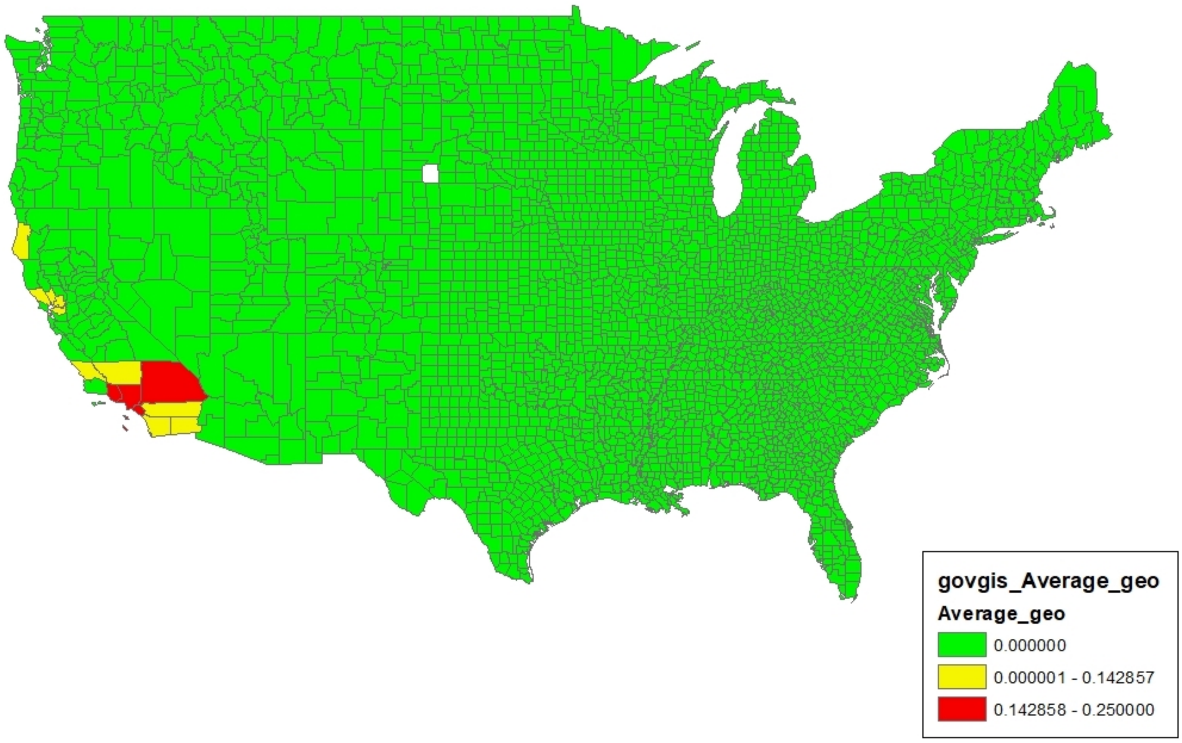
The governor's spatial analysis in Figure 5 shows on average which counties have climatological events during a governor's election year.

Figure 5: Governor average climatalogical frequency per FIPS



3.4.2 Geophysical analysis

Figure 6: Governor average geophysical frequency per FIPS



The governor's spatial analysis in Figure 6 shows on average which counties have geographical events during a governor's election year.

The geophysical variable is negatively statistically significant only in model 4, no interaction with race. Without the interaction with geophysical, all races in this study vote significantly less than Whites in terms of the population percentage. This finding supports the assumption that Whites, as the majority race in the US, will vote in the governor's election regardless of a geophysical natural disaster or not and without interaction minorities will significantly vote less when compared to White voters in terms of the total population percentage.

With geophysical interaction, models 5 and 6, all five race categories have statistical significance with Asians and Natives having statistical significance and voting more in terms of the White population percentage. With interaction Blacks, Hispanics, and Two or more statistically vote less when compared to White voters in terms of the total population percentage.

Why do Asians and Natives have a positive statistical significance after a geophysical event and Blacks, Hispanics, and Two or more are less? Is this lack of voter participation by Blacks, Hispanics, and Two or more the result of the higher voting costs after a geophysical event for these groups? Two possible answers are the incumbent governor is punished for lack of response to the disaster Rissmann (2016) or because of an economic and geographical interpretation partly based on Anbarci et al. (2005),Visconti (2018), and Rissmann (2016). Economics plays a part as rich citizens, based on per capita income and inequality, have insurance for future disasters and the poor are left with nothing. After an earthquake a change in individual preferences and priorities occur, namely housing especially if the voter has no property insurance she probably tend to not voting because of trying to secure housing. A possibility exists because of the location of Native reservations which tend less to have geophysical disasters and thus allow for a lower cost to voting leading to increasing the Native voter turnout. Minorities tend to live in higher concentrated metropolitan areas and Asians vote at a higher rate according to Diaz (2012). A conclusive answer to these questions are, however beyond the scope of this study and would need further research as only supposition would provide an answer.

The election variables in model 6, margin of winning votes is not significant while the governor's Democratic percentage of votes is highly significant. This shows that accounting for geophysical disasters and the interaction between geophysical and race and ethnicity, there is a positive affect on the increase of Democratic votes compared to the total governor votes.

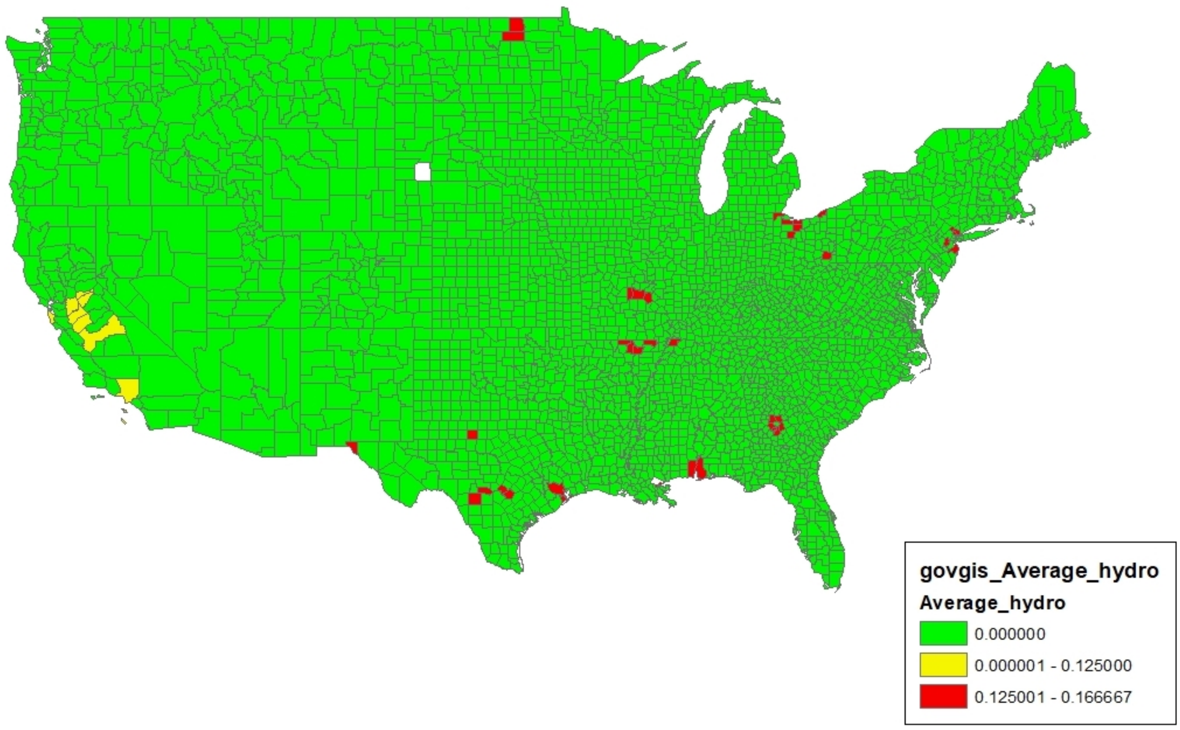
3.4.3 Hydrological analysis

Hydrological disasters, e.g., flooding, are not statistically significant in model 7, but are statistically significant in the interaction models 8 and 9. Without hydrological interaction all five races are statistically significant and vote less than Whites in terms of the population percentage. This finding supports the assumption that Whites, as the majority race in the US, will vote in the governor's election regardless of a hydrological natural disaster or not.

With hydrological interaction in both models 8 and 9 only Hispanics and Natives vote less when compared to the White voter population percentage. Perhaps, because of a hydrological disaster it impacts the geographical location where Hispanics and Natives tend to live. Such an assumption seems reasonable, that if their homes and jobs are flooded the cost to vote is higher than securing housing and work however Sinclair et al. (2011) noted those who experienced flooding less than 6' of water tended not to vote.

The election variables in model 9, margin of winning votes is not significant while the governor's Democratic percentage of votes is highly significant. This shows that accounting for hydrological and the interaction between hydrological and race and ethnicity there is a positive affect on the increase of Democratic votes compared to the total Governor votes.

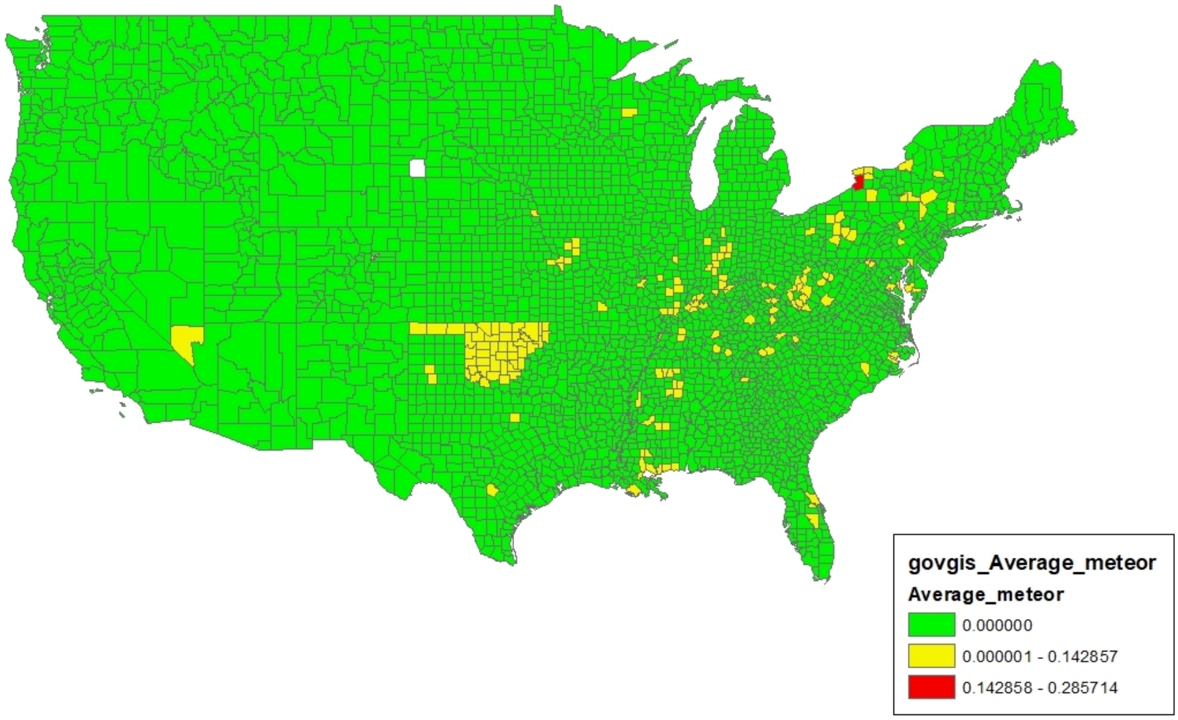
Figure 7: Governor average hydrological frequency per FIPS



The governor's spatial analysis in Figure 7 shows on average which counties have hydrological events during a governor's election year.

3.4.4 Meteorological

Figure 8: Governor average meteorological frequency per FIPS



The governor's spatial analysis in Figure 8 shows on average which counties have meteorological events during a governor's election year.

The meteorological variable has no statistical significance in all three models, 10, 11, and 12, with and without interaction with race. Without interaction with the meteorological variable all five races vote statistically significantly less than Whites in terms of the population percentage. This finding supports the assumption that Whites, as the majority race in the US, will vote in the governor's election regardless of a meteorological natural disaster or not.

In the interaction between race and meteorological disasters, all five race categories have statistical significance with only Two or more races voting statistically significantly more than Whites in terms of the population percentage. Meteorological disasters, by EM-DAT definition, are "short-lived, micro-to mesoscale extreme weather... that last from minutes to days." Meteorological disaster examples are hurricanes, thunderstorms, and tornadoes. These are the disasters that happen suddenly and annually. This study, using the EM-DAT meteorological definition, can explain why the Asians, Hispanics, Blacks, and Native percentages tend to vote less than Whites in terms of the population percentage because quite possibly the cost of voting is much higher than securing housing and jobs under meteorological disaster conditions. This study cannot explain why only individuals who claim Two or more races would vote more in governor elections under meteorological conditions than Whites in terms of the total population percentage.

The election variables in model 9, margin of winning votes is not significant while the governor's Democratic percentage of votes is highly significant. This shows that accounting for meteorological disasters and the interaction between meteorological disasters and race there is a positive affect on the increase of Democratic votes compared to the total Governor votes.

3.4.5 Governor residual analysis

The residual scatterplots, models 3, 6, 9, and 12, show a symmetric consistency in the models with clustering less than 1 with one consistent outlier in all four disaster categories, FIPS 48301 Loving county, TX in the year 1998. All other residuals in the four disaster categories are less than 1. The reason for this residual outlier is an election data entry error from the original data source. 48301 had a total population of 63 people, aged twenty and upwards, yet the data records a governor vote total of 108. Because the DV, $y1 = \frac{\text{governor total vote}}{\text{potential population}}$, and the denominator includes the white population, the residual becomes an outlier.

Figure 9: Governor climatological residuals scatterplot

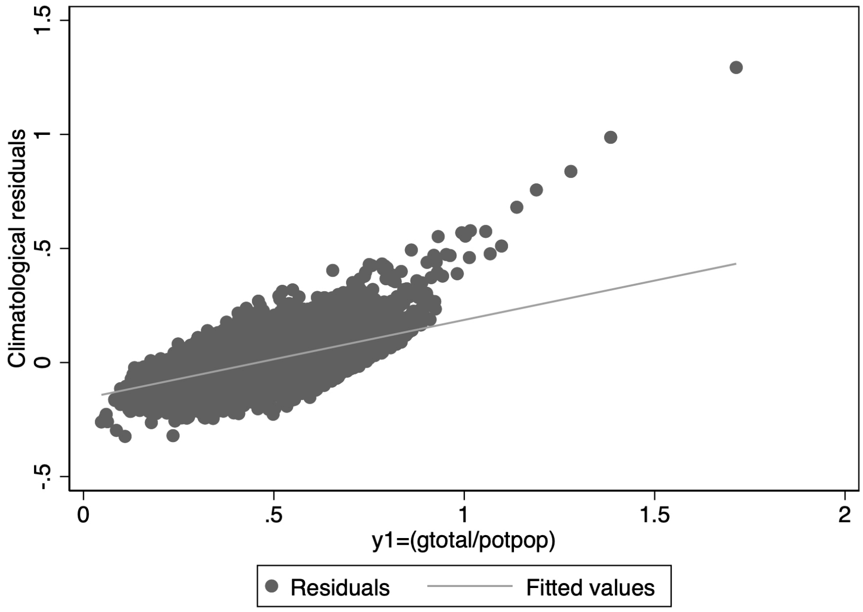


Figure 10: Governor geophysical residuals scatterplot

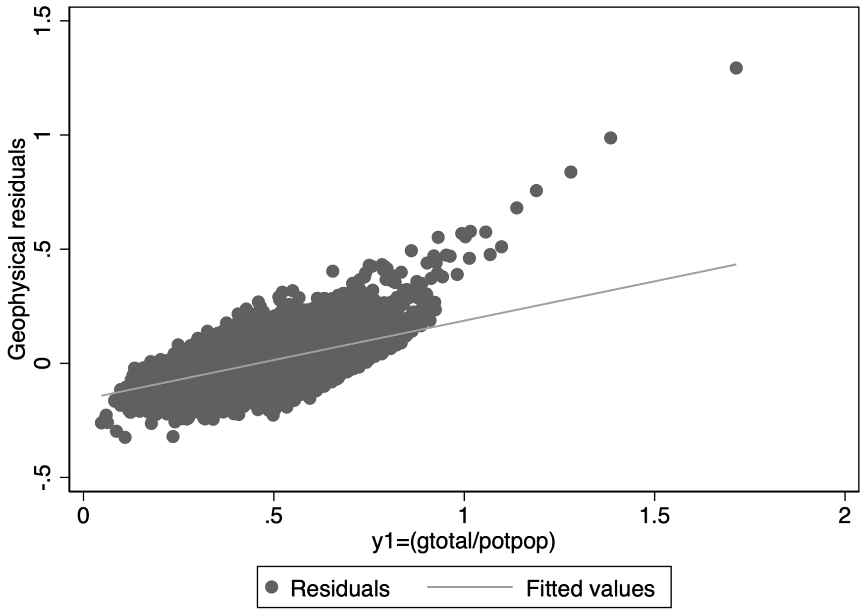


Figure 11: Governor hydrological residuals scatterplot

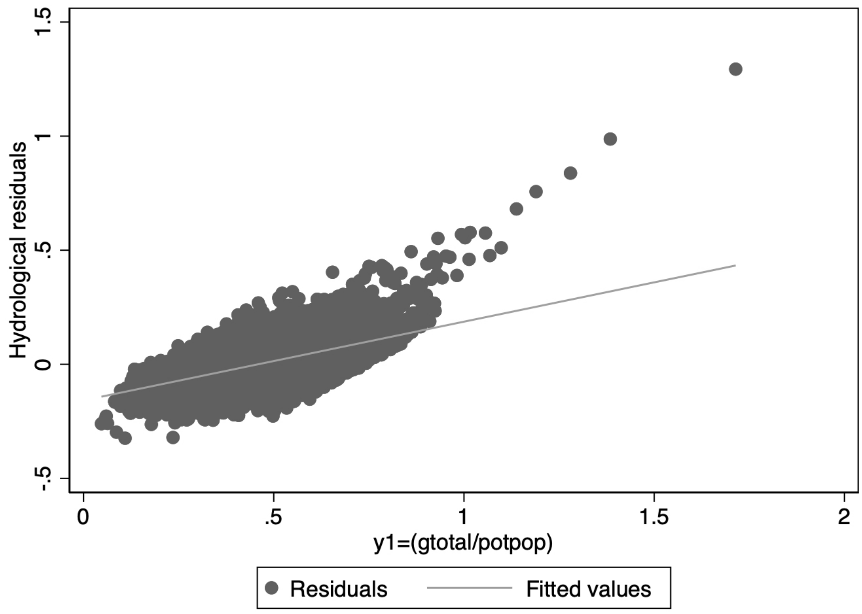
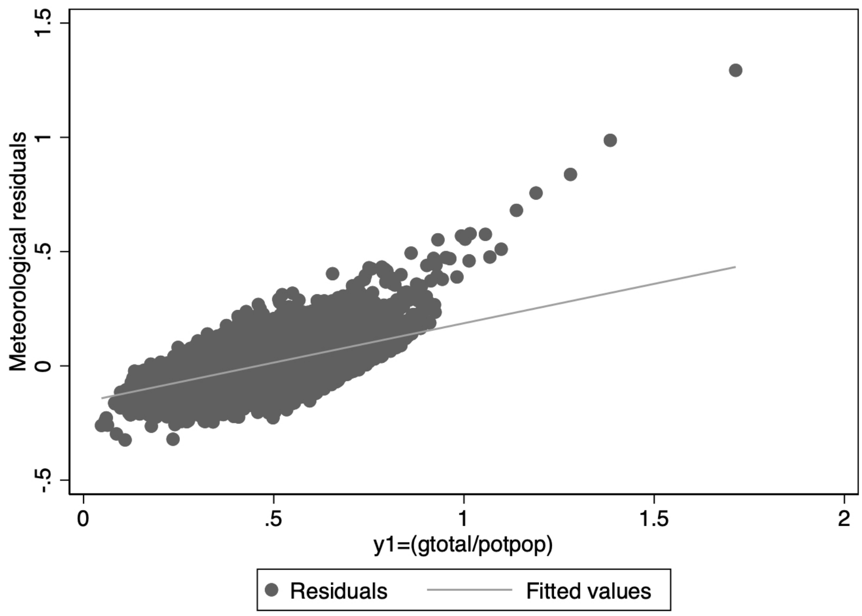


Figure 12: Governor meteorological residuals scatterplot



3.4.6 Governor race conclusions

Without interaction between the natural disaster and race and ethnicity each of these models in the most conservative form, models 1, 4, 7, and 10 show Asians, Blacks, Hispanics, Natives, and Two or more races, vote statistically significantly less than Whites in terms of population percentage. This finding supports the disaster voting literature regarding minority groups. One may possibly explain this in terms of voter suppression or just the lack of interest by minorities in gubernatorial races. With the disaster interaction this statistical significance changes. However, these four models show only Hispanics and Natives consistently tend not to interact with the governor voting process in all four disaster types. This study makes no assumption to why but just notes the statistical significance.

In all four models—3, 6, 9, and 12—the percentage vote for Democrat governor candidates are highly statistically significant. Because of the two party system in the US, one can reasonably expect if Democrats receive a statistically significant higher percentage number of votes, then similarly, Republican governors receive a statistically significant lower percentage number of votes when one of these four EM-DAT disasters occur.

Figure 13: Governor average DV, y1

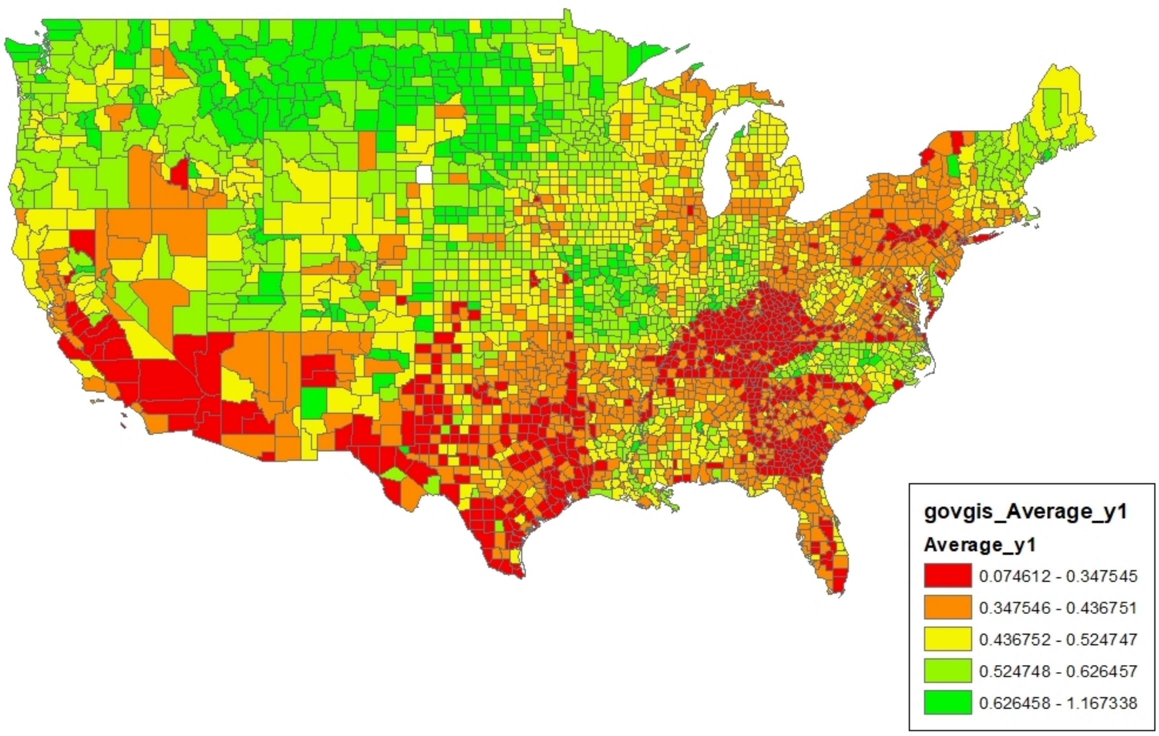


Figure 13 illustrates the average minority voter turnout overtime for FIPS having the four natural disaster categories. Spatially, this map shows where minority races do not vote and many of these areas are where natural disasters occur in the years of a governor's election.

3.5 House election analysis

US House elections occur every two years for every House seat as mandated by the Constitution. All of the models in the House analysis compare the election turnout to Whites as these models focuses upon Asians, Blacks, Hispanic ethnicity, Natives, and Two races or more as categorized by the US Census Bureau.

Table 17 displays all of the linear regression results of the disasters and House elections for the years in the analysis. This study uses three models per each disaster category. β_1 is a disaster dummy variable coded $\beta_1 = 1$ if the disaster occurred and $\beta_1 = 0$ otherwise in each of the disaster categories. The calculation for the DV is $y1 = \frac{htotal}{pottot}$ where the numerator htotal represents the House race total election votes and the denominator represents the sum of the potential total voters in the county. All of the DVs follow the same format with the only change in the numerator for each elected office total votes. The denominator never changes. The House regression results follow in Table 17.

Models 1, 4, 7, and 10 use Equation (17). β_1 is a disaster dummy variable coded $\beta_1 = 1$ if the disaster occurred and $\beta_1 = 0$ otherwise. The purpose of Equation (17) determines if disasters have any impact at all on the individual races and ethnicities and is the most basic format. Equation (17) has an underlying assumption that disasters do not affect minority voter turnout.

$$y1 = \alpha + \beta_1 \text{disaster} + \beta_2 \text{race} + \beta_3 (\text{individual year}) + \epsilon \tag{17}$$

Models 2, 5, 8, and 11 follow the follow format of Equation (17) but includes an interaction variable between the disaster and the races and tests the assumption that natural disasters do impact the individual minority groups.

$$y1 = \alpha + \beta_! \text{disaster} + \beta_2 (\text{disaster } \times \text{race}) + \beta_3 (\text{individual year}) + \epsilon \tag{18}$$

Models 3, 6, 9, and 12 include the format of Equation (18) but adds two election variables resulting in Equation (19).The election data variables are the margin of winning vote percentage and the Democrat party percentage of the total votes. The winning vote percentage does not differentiate between parties or candidates, just what the winning percentage was of the total votes cast. The two reasons why it does not matter if this study used the Democratic party or Republican party as independent variables: First, because if both variables were in the regression one would have been dropped because of collinearity and second, because the US has two major parties, Democrats and Republicans, and a win or loss by one party is the inverse of the other at election time.

$$y1 = \alpha + \beta_! \text{disaster} + \beta_2(\text{disaster } \times \text{race}) + \beta_3(\text{individual year}) + \beta_4(\text{election data}) + \epsilon \quad (19)$$

The House regression results follow in Table 17.

Table 17: House disaster regression results
DV vote turnout

	Climatological			Geophysical			Hydrological			Meteorlogoical		
VARIABLES	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
climatological	-0.0193***	-0.0173	-0.00895									
	(0.00505)	(0.0168)	(0.0149)									
house margin			4.82e-08			4.52e-08			4.57e-08			4.63e-08
			(3.40e-08)			(3.45e-08)			(3.46e-08)			(3.43e-08)
house dem %			0.0707***			0.0707***			0.0709***			0.0706***
			(0.00422)			(0.00423)			(0.00423)			(0.00422)
asian %	0.563***	0.562***	0.323***	0.561***	0.563***	0.324***	0.562***	0.565***	0.326***	0.554***	0.562***	0.325***
	(0.113)	(0.113)	(0.102)	(0.113)	(0.113)	(0.102)	(0.113)	(0.113)	(0.102)	(0.113)	(0.114)	(0.103)
black %	-0.198***	-0.198***	-0.260***	-0.198***	-0.198***	-0.260***	-0.198***	-0.198***	-0.261***	-0.198***	-0.198***	-0.260***
	(0.0664)	(0.0664)	(0.0636)	(0.0663)	(0.0664)	(0.0636)	(0.0663)	(0.0663)	(0.0637)	(0.0662)	(0.0660)	(0.0633)
hispanic %	-0.488***	-0.488***	-0.478***	-0.488***	-0.489***	-0.479***	-0.488***	-0.488***	-0.479***	-0.489***	-0.488***	-0.479***
	(0.0333)	(0.0333)	(0.0321)	(0.0334)	(0.0334)	(0.0322)	(0.0333)	(0.0333)	(0.0321)	(0.0333)	(0.0332)	(0.0321)
native %	-1.130***	-1.130***	-1.090***	-1.130***	-1.129***	-1.089***	-1.130***	-1.128***	-1.088***	-1.126***	-1.107***	-1.066***
	(0.138)	(0.138)	(0.129)	(0.138)	(0.138)	(0.129)	(0.138)	(0.138)	(0.129)	(0.138)	(0.137)	(0.128)
two %	-0.599***	-0.599***	-0.731***	-0.601***	-0.603***	-0.735***	-0.601***	-0.605***	-0.737***	-0.604***	-0.677***	-0.811***
	(0.125)	(0.125)	(0.106)	(0.125)	(0.124)	(0.105)	(0.125)	(0.125)	(0.106)	(0.126)	(0.125)	(0.106)
1.climate#c.asian %		0.107**	0.107*									
		(0.0459)	(0.0560)									
1.climate#c.black %		0.158	0.0990									
		(0.101)	(0.110)									
1.climate#c.hispanic %		-0.0568*	-0.0710**									
		(0.0292)	(0.0283)									
1.climate#c.native %		0.117	0.138									
		(0.107)	(0.127)									
1.climate#c.two %		-0.365	-0.608									
		(0.510)	(0.587)									
geophysical				-0.00264	0.0349	0.0226						
				(0.00795)	(0.0220)	(0.0253)						
1.geo#c.asian %					-0.0186	0.00736						
					(0.168)	(0.184)						
1.geo#c.black %					-0.0653	0.0254						
					(0.245)	(0.290)						
1.geo#c.hispanic %					-0.141***	-0.105**						
					(0.0380)	(0.0448)						
1.geo#c.native %					-0.274	-0.0334						
					(0.508)	(0.634)						
1.geo#c.two %					0.115	0.0745						
					(0.336)	(0.375)						
hydrological							-0.000669	0.00201	-0.00721			
							(0.00500)	(0.00732)	(0.00823)			

Continued on next page

Table 17 – continued from previous page

	Climatological			Geophysical			Hydrological			Meteorlogoical		
VARIABLES	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
1.hydro#c.asian %								-0.207*	-0.177			
								(0.120)	(0.138)			
1.hydro#c.black %								0.0339	0.0758			
								(0.0633)	(0.0689)			
1.hydro#c.hispanic %								0.0423	0.0659*			
								(0.0298)	(0.0351)			
1.hydro#c.native %								-3.010***	-3.126***			
								(0.444)	(0.539)			
1.hydro#c.two %								1.049**	1.023**			
								(0.452)	(0.513)			
meteorological										0.0141***	-0.00724	-0.00422
										(0.00273)	(0.00529)	(0.00508)
1.meteor#c.asian %											-0.233***	-0.243***
											(0.0462)	(0.0388)
1.meteor#c.black %											0.0101	0.0138
											(0.0294)	(0.0265)
1.meteor#c.hispanic %											-0.0480***	-0.0456***
											(0.0139)	(0.0131)
1.meteor#c.native %											-1.212***	-0.925***
											(0.395)	(0.348)
1.meteor#c.two %											4.355***	3.807***
											(0.855)	(0.779)
year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Constant	0.614***	0.614***	0.583***	0.614***	0.614***	0.583***	0.614***	0.614***	0.583***	0.614***	0.614***	0.583***
	(0.00586)	(0.00586)	(0.00587)	(0.00586)	(0.00587)	(0.00588)	(0.00586)	(0.00586)	(0.00588)	(0.00585)	(0.00583)	(0.00585)
Observations	40,182	40,182	40,182	40,182	40,182	40,182	40,182	40,182	40,182	40,182	40,182	40,182
R-squared	0.644	0.644	0.655	0.644	0.644	0.655	0.644	0.644	0.655	0.644	0.645	0.656
Number of FIPS	3,113	3,113	3,113	3,113	3,113	3,113	3,113	3,113	3,113	3,113	3,113	3,113

Robust standard errors in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

3.5.1 Climatological analysis

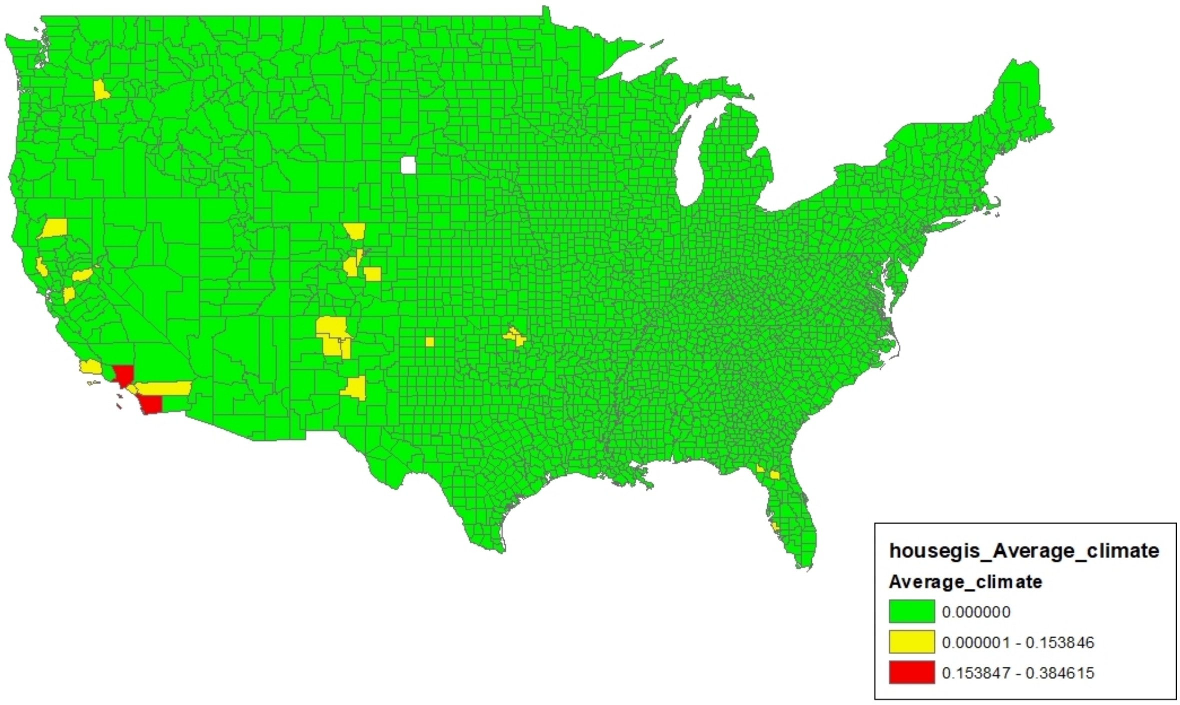
Climatological model 1 shows the climatological variable is negatively statistically significant on a House election when not interacted with the races and ethnicities. Blacks, Hispanics, Natives, and Two or more in model 1 are negatively statistically significant and compared to Whites tend to vote less than the total population. Asians are statistically significant and tend to vote more than Whites under non-interactive climatic conditions when compared to Whites in the total population percentage.

In models 2 and 3 the climate is no longer statistically significant however, with this interaction Asians vote statistically significantly more than Whites in terms of the White population percentage and Hispanics vote statistically significantly less than Whites when compared to the total population. Three possible suggestions for this exist. First, an economic interpretation where income per capita may play a role, second, a general malaise regarding House elections, i.e., no interest in the candidates, for Hispanics when compared to Asians. Third, the voting cost for a House election is too high. These ideas are open to further study. These findings supports the assumption that Whites, as the majority race in the US, votes in House elections regardless of a climate disaster or not.

The election variables in model 3, margin of winning votes is not significant while the House's Democratic percentage of votes is highly significant. This shows that accounting for climate and interaction between climate and race there is a positive affect on the increase of Democratic votes to the total House votes.

The House spatial analysis in Figure 14 shows on average which counties have climatological events during a House election year.

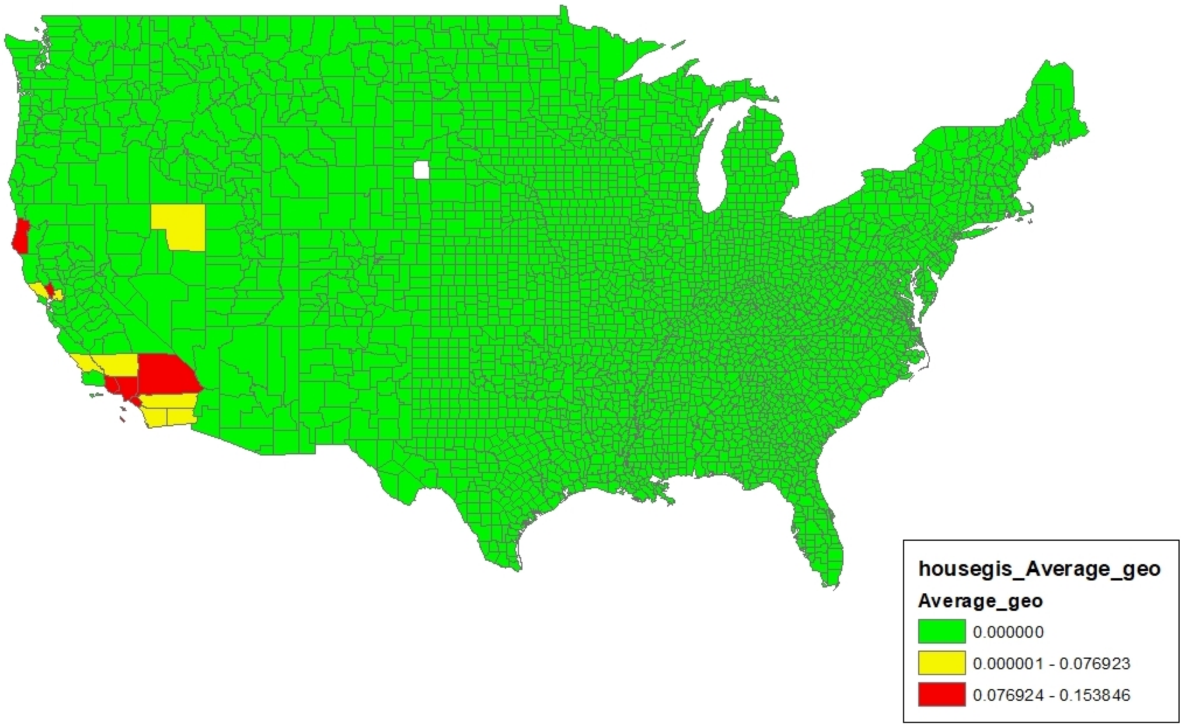
Figure 14: House average climatological frequency per FIPS



3.5.2 Geophysical analysis

The House spatial analysis in Figure 15 shows on average which counties have geophysical events during a House election year.

Figure 15: House average geophysical frequency per FIPS



The geophysical variable has no significance in all three House election models, 4-6.

The same racial ethnic pattern appears with no interaction appears in model 4—Asians vote statistically significantly more than Whites in terms of the total population percentage in all three models and the others Blacks, Hispanics, Natives, and Two or more vote statistically significantly less than Whites in terms of the total population percentage.

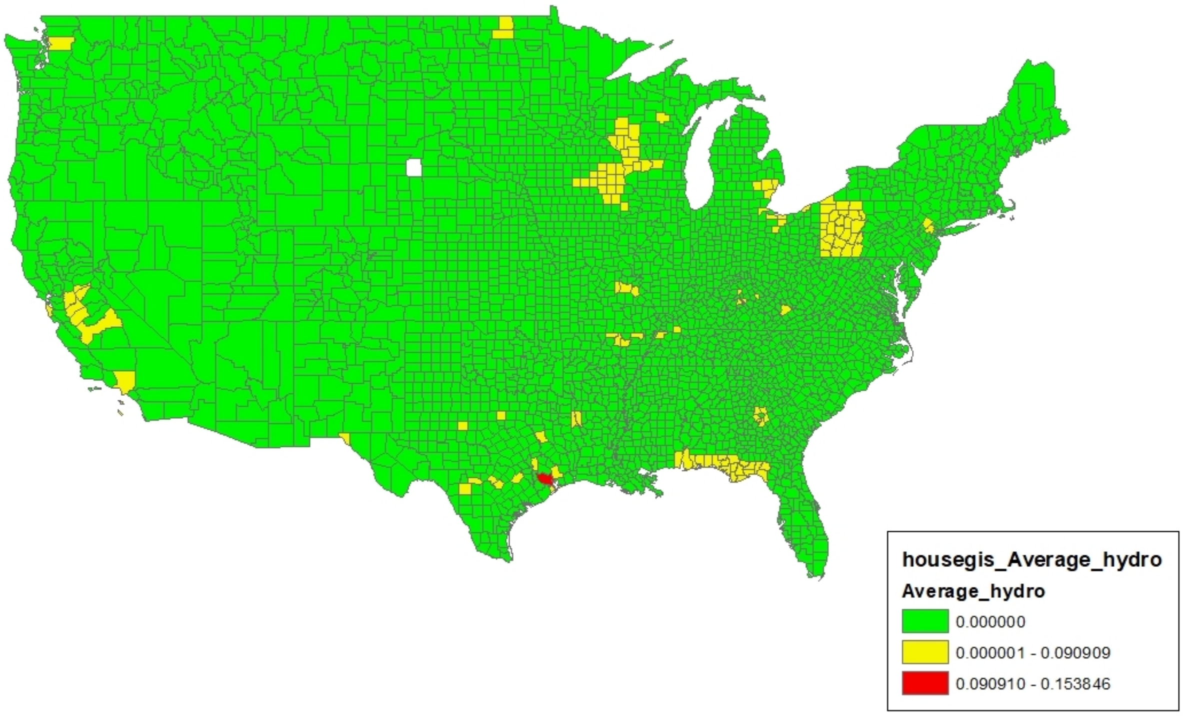
With geophysical interaction, models 5 and 6, only the Hispanics interaction with geophysical has statistical significance and the interaction results show Hispanics vote relatively less than Whites in terms of the total population percentage. This study suggests again that perhaps socioeconomic status, lack of interest, and voting cost in a House election when a geophysical event occurs discourages Hispanics to significantly tend to not vote when compared to Whites in terms of the total population percentage.

The election variables in model 6, margin of winning votes is not significant while the House's Democratic percentage of votes is highly significant. This shows that accounting for geophysical and interaction between geophysical and race and ethnicity here is a positive affect on in the increase of Democratic votes to the total Governor votes when compared to the House votes.

3.5.3 Hydrological analysis

The House spatial analysis in Figure 16 shows on average which counties have hydrological events during a House election year.

Figure 16: House average hydrological frequency per FIPS



The hydrological variable, like the geophysical variable, has no statistical significance across all three models, 7, 8 , and 9. With no interaction between hydrological and race, all of the races and ethnicities are statistically significant. Asian's vote relatively more than Whites in terms of the total population percentage in model 7 and the other races and ethnicities voting relatively less than Whites in terms of the total population percentage.

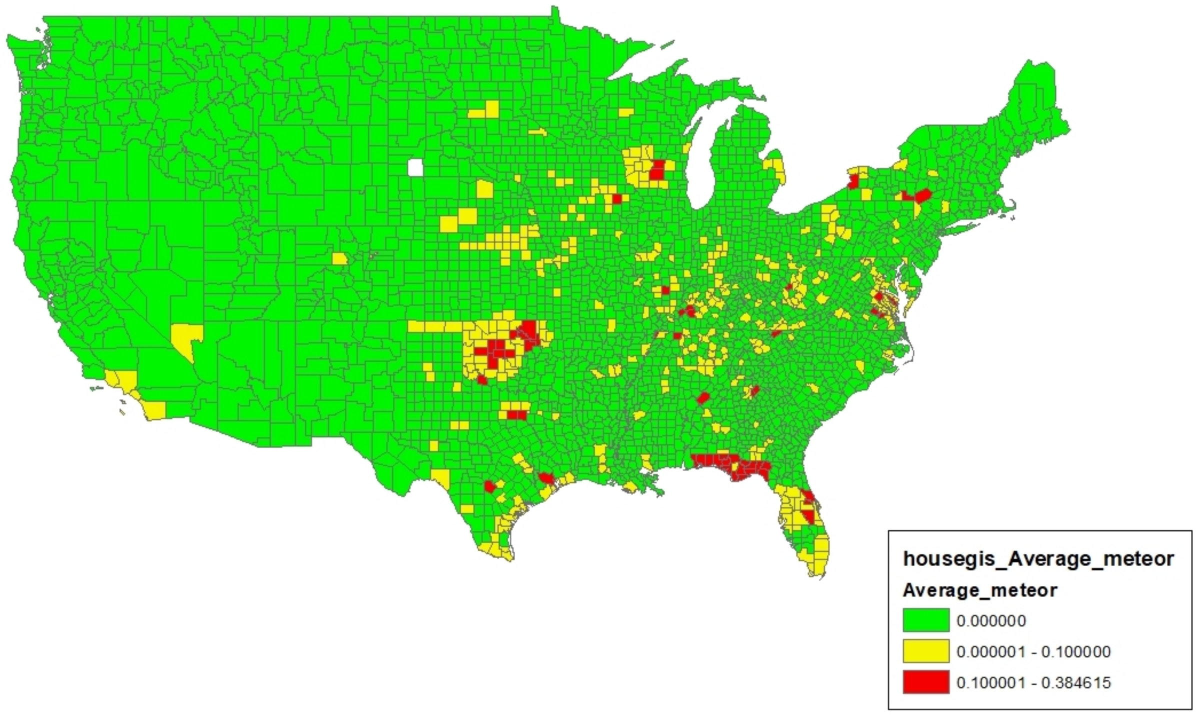
Using model 8, hydrological interacting with race, shows Asians, Natives, and Two or more groups have statistical significance with the tendency for Asians and Natives voting statistically significantly less than Whites in terms of the total population percentage. Many Natives are located in isolated geographical areas and the possibility of flooded roads prevents Natives from traveling to and from polling stations. Two or more groups are more likely to vote in House elections relative to Whites in terms of the total population percentage. Hawaii and Oklahoma have the highest percentage of people who identify as Two or more races. Hawaii has counties that range from 12.6% to 19.8% of the potential population of the county identifying as Two or more races. However, when a hydrological event occurs it happened only in Honolulu (15003 FIPS) and Kauai (15007 FIPS). Honolulu's event occurred in 2004 and Kauai in 2006. The possibility exists that the interest of Two or more in the House races in Hawaii happened because of local politics and had nothing to do with the House election or the hydrological event.

The election variables in model 9, margin of winning votes is not significant while the House's Democratic percentage of votes is highly significant. This shows that accounting for climate and interaction between climate and race and ethnicity there is a positive affect in the increase of Democratic votes to the total House votes.

3.5.4 Meteorological

The House spatial analysis in Figure 17 shows on average which counties have meteorological events during a House election year.

Figure 17: House average meteorological frequency per FIPS



The meteorological variable only shows statistical significance when it does not interact with race as in model 10. All of the same race statistical significant patterns as in the climatological, geophysical, and hydrological outcomes appear. Only Asians tend to vote significantly more than Whites in terms of the total population percentage. The other race groups, Blacks, Hispanics, Natives, and Two or more tend not to vote with statistical significance when compared to Whites in terms of the total population percentage.

With interaction between disaster and races, models 11 and 12 produce similar results. Only Two or more tend to vote significantly more than Whites when compared to the total population percentage. Asians, Hispanics, and Natives vote statistically significantly less than Whites when compared to the total population percentage.

The election variables in model 12, margin of winning votes is not statistically significant while the House's Democratic percentage of votes is highly significant. This shows that accounting for meteorological disasters and interaction between meteorological and race and ethnicity there is a positive affect on in the increase of Democratic votes to the total House votes.

3.5.5 House residual analysis

The residual scatterplots, models 3, 6, 9, and 12, show a symmetric consistency in the models with clustering less than 1 with one consistent outlier in all four disaster categories, 48301 Loving county, TX in the years 1998 and 2000. All other FIPS residuals in the four disaster categories are less than 1. The reason for this residual outlier is an election data entry error from the original data source. 48301 had a total population of 63 and 52 people in the years 1998 and 2000, respectfully, aged twenty and upwards. The election data records a House vote total of 94 and 134. Because the DV, $y1 = \frac{\text{house total vote}}{\text{potential population}}$, and the denominator includes the white population, the residual becomes an outlier.

Figure 18: House climatological residuals scatterplot

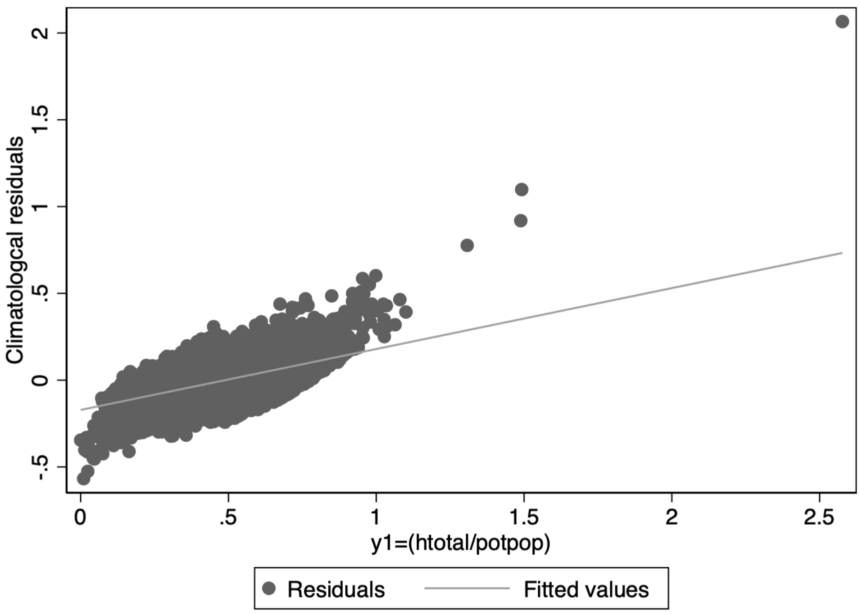


Figure 19: House geophysical residuals scatterplot

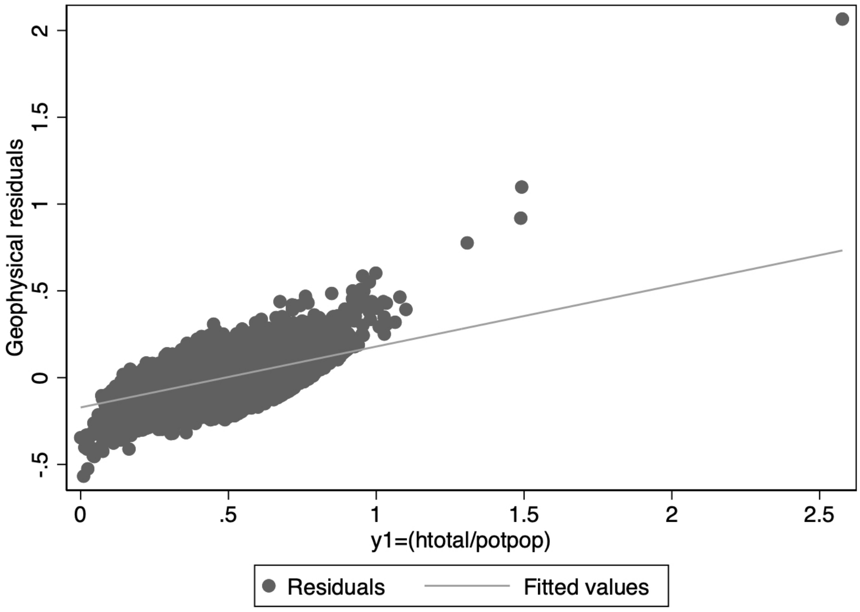


Figure 20: House hydrological residuals scatterplot

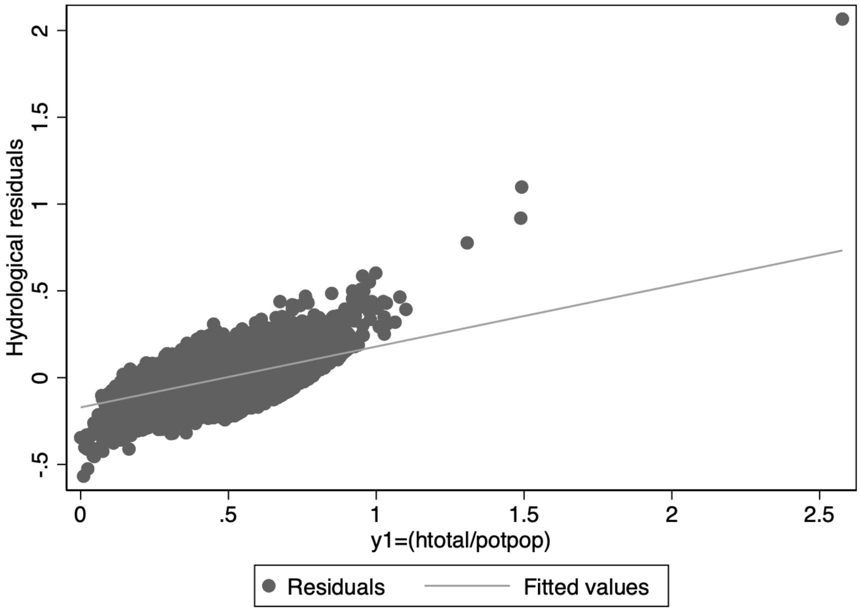
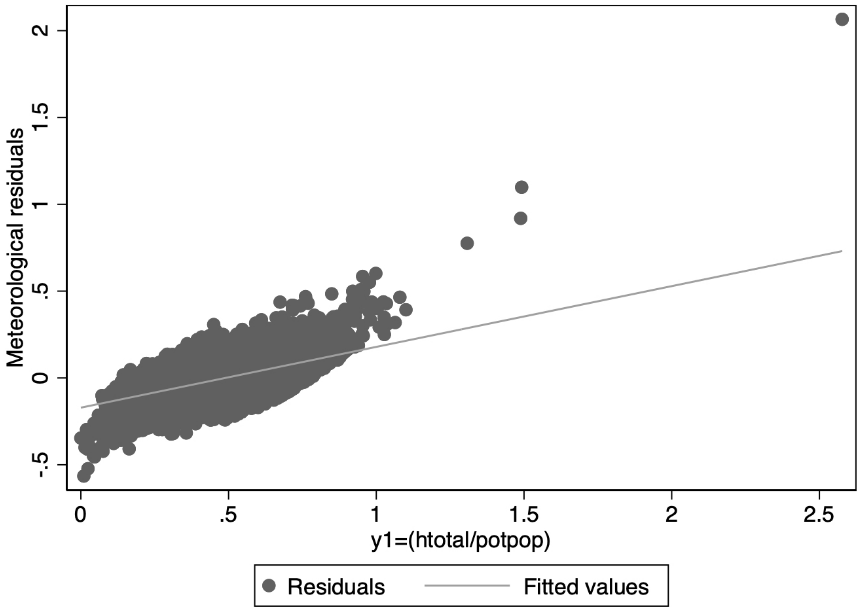


Figure 21: House meteorological residuals scatterplot



3.5.6 House election conclusions

The research questions focus on two areas, natural disaster impact on minority voter turnout and which disasters have statistical significance on minority voter turnout. The House natural disaster regression results offer a mixed bag of voter turnout when compared to Whites in terms of the total population when the disaster interacts with race and ethnicity. Of the four disaster categories, Asians tend to vote more than Whites when a climatological disaster occurs. Blacks are not statistically significant under any of this study's natural disaster categories with interaction. Hispanics tend to vote less in climatological, geophysical, and meteorological disasters, yet more under hydrological disaster conditions. Native Americans are statistically significant to tend to vote less than Whites in terms of the total population percentage in hydrological and meteorological disasters. Two or more voters when disaster interaction occurs they tend to vote statistically more than Whites in terms of the total population percentage under hydrological and meteorological disasters.

Natural disasters do impact minority voters but it depends on the minority group and some of these consequences are statistically significant but only with regard to the minority impacted group. None of the four disaster categories statistically significantly affect all—Asians, Blacks, Hispanics, Native Americans, and Two or more—equally or statistically significantly under the same disaster. Thus, the research questions are only partially answered under these models for House elections.

In all four models the House Democratic percentage of total House votes was statistically significant.

Figure 22: House average DV, y1

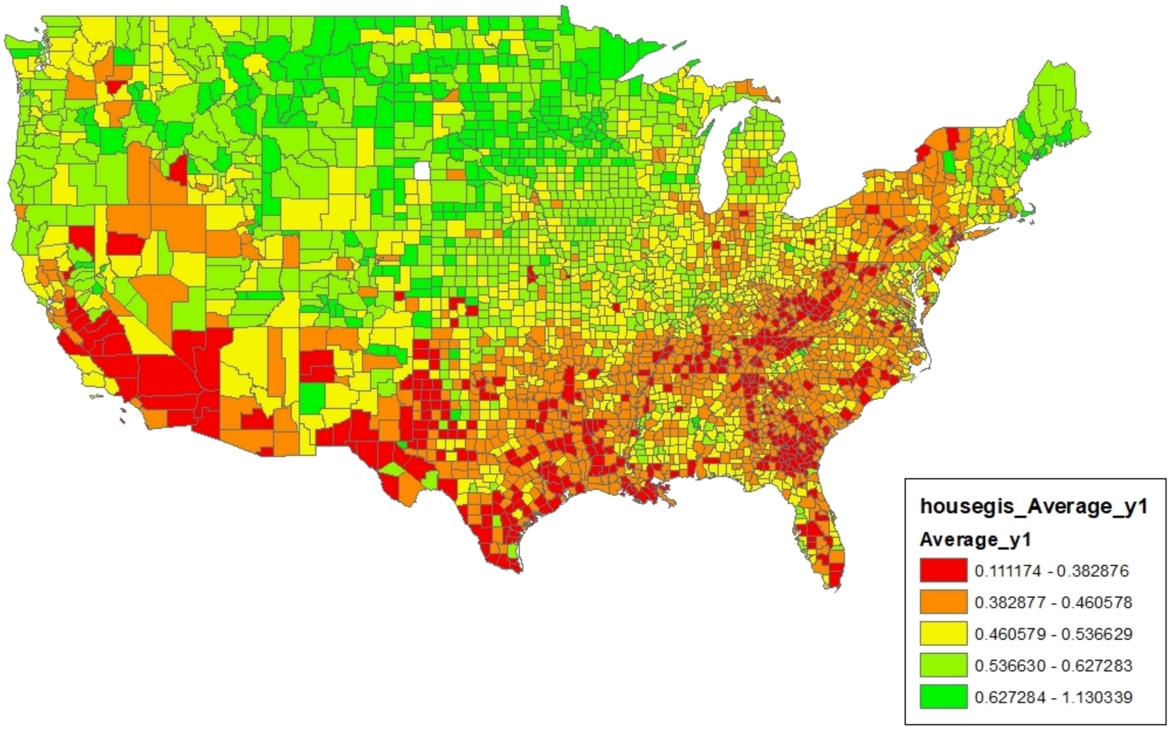


Figure 22 illustrates the average minority voter turnout overtime for FIPS having the four natural disaster categories. Spatially, this map shows where minority races do not vote and many of these areas are where natural disasters occur in the years of a House election.

3.6 POTUS election analysis

POTUS elections occur every four years as mandated by the Constitution. All of the models in the POTUS analysis compare the election turnout to Whites as these models focuses upon Asians, Blacks, Hispanic ethnicity, Natives, and Two races or more as categorized by the US Census Bureau.

Table 18 displays all of the linear regression results of the disasters and POTUS elections for the years in the analysis. This study uses three models per each disaster category. β_1 is a disaster dummy variable coded $\beta_1 = 1$ if the disaster occurred and $\beta_1 = 0$ otherwise in each of the disaster categories. The calculation for the DV is $y1 = \frac{ptotal}{pottot}$ where the numerator ptotal represents the POTUS race total election votes and the denominator represents the sum of the potential total voters in the county. All of the DVs follow the same format with the only change in the numerator for each POTUS total votes based upon the FIPS. The denominator never changes. The POTUS regression results follow in Table 18.

Models 1, 4, 7, and 10 use Equation (20). β_1 is a disaster dummy variable coded $\beta_1 = 1$ if the disaster occurred and $\beta_1 = 0$ otherwise. The purpose of Equation (20) determines if disasters have any impact at all on the individual races and ethnicities and is the most basic format. Equation (20) has an underlying assumption that disasters do not affect minority voter turnout.

$$y1 = \alpha + \beta_1\text{disaster} + \beta_2\text{race} + \beta_3(\text{individual year}) + \epsilon \tag{20}$$

Models 2, 5, 8, and 11 follow the follow format of Equation (21) but includes an interaction variable between the disaster and the races and tests the assumption that natural disasters do impact the individual minority groups.

$$y1 = \alpha + \beta_!\text{disaster} + \beta_2(\text{disaster } \times\text{race}) + \beta_3(\text{individual year}) + \epsilon \tag{21}$$

Models 3, 6, 9, and 12 include the format of Equation (21) but adds two election variables. The election data variables are the margin of winning vote percentage and the Democrat party percentage of the total votes. The winning vote percentage does not differentiate between parties or candidates, just what the winning percentage was of the total votes cast. The two reasons why it does not matter if this study used the Democratic party or Republican party as independent variables: First, because if both variables were in the regression one would have been dropped because of collinearity and second, because the US has two major parties, Democrats and Republicans, and a win or loss by one party is the inverse of the other at election time.

$$y1 = \alpha + \beta_{!}\text{disaster} + \beta_2(\text{disaster } \times \text{race}) + \beta_3(\text{individual year}) + \beta_4(\text{election data}) + \epsilon \quad (22)$$

The POTUS regression results follow in Table 18.

Table 18: POTUS disaster regression results
DV vote turnout

	Climatological			Geophysical			Hydrological			Meteorlogoical		
VARIABLES	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
climatological	-0.0219***	-0.0204*	0.000389									
	(0.00556)	(0.0116)	(0.0130)									
potus margin			2.38e-07***			2.36e-07***			2.27e-07**			2.29e-07***
			(8.83e-08)			(8.88e-08)			(9.31e-08)			(8.68e-08)
potus dem %			0.168***			0.168***			0.168***			0.167***
			(0.00817)			(0.00817)			(0.00817)			(0.00815)
asian %	0.667***	0.666***	0.102	0.663***	0.667***	0.106	0.665***	0.666***	0.103	0.657***	0.680***	0.125
	(0.122)	(0.122)	(0.108)	(0.122)	(0.123)	(0.109)	(0.122)	(0.122)	(0.108)	(0.122)	(0.125)	(0.110)
black %	-0.0794	-0.0791	-0.212***	-0.0787	-0.0791	-0.211***	-0.0789	-0.0799	-0.212***	-0.0785	-0.0779	-0.208***
	(0.0696)	(0.0696)	(0.0647)	(0.0695)	(0.0696)	(0.0647)	(0.0695)	(0.0697)	(0.0648)	(0.0694)	(0.0690)	(0.0643)
hispanic %	-0.458***	-0.458***	-0.497***	-0.459***	-0.460***	-0.497***	-0.458***	-0.458***	-0.496***	-0.459***	-0.458***	-0.495***
	(0.0352)	(0.0352)	(0.0332)	(0.0353)	(0.0353)	(0.0334)	(0.0352)	(0.0352)	(0.0333)	(0.0351)	(0.0353)	(0.0334)
native %	-1.171***	-1.170***	-1.145***	-1.170***	-1.169***	-1.144***	-1.170***	-1.168***	-1.141***	-1.168***	-1.149***	-1.127***
	(0.170)	(0.170)	(0.150)	(0.170)	(0.170)	(0.150)	(0.170)	(0.170)	(0.150)	(0.170)	(0.169)	(0.150)
two %	-0.513***	-0.513***	-0.834***	-0.519***	-0.516***	-0.836***	-0.517***	-0.519***	-0.843***	-0.516***	-0.609***	-0.914***
	(0.161)	(0.161)	(0.105)	(0.161)	(0.162)	(0.105)	(0.161)	(0.162)	(0.105)	(0.162)	(0.162)	(0.104)
1.climate#c.asian %		0.0300	-0.0795									
		(0.0494)	(0.0594)									
1.climate#c.black %		-0.00544	-0.136**									
		(0.0825)	(0.0682)									
1.climate#c.hisp %		0.0126	-0.0512*									
		(0.0268)	(0.0289)									
1.climate#c.native %		-0.287*	-0.113									
		(0.172)	(0.132)									
1.climate#c.two %		0.141	-0.391									
		(0.594)	(0.576)									
geophysical				-0.0104	0.0121	-0.0396**						
				(0.00899)	(0.0197)	(0.0182)						
1.geo#c.asian %					0.390**	0.739***						
					(0.198)	(0.175)						
1.geo#c.black %					-0.278	0.428*						
					(0.204)	(0.226)						
1.geo#c.hisp %					-0.148***	-0.0813***						
					(0.0245)	(0.0313)						
1.geo#c.native %					0.163	0.834						
					(0.453)	(0.624)						
1.geo#c.two %					1.185	1.346						
					(1.240)	(1.796)						
hydrological							0.00177	-0.00665	-0.00398			
							(0.00346)	(0.00524)	(0.00497)			

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Table 18 – continued from previous page

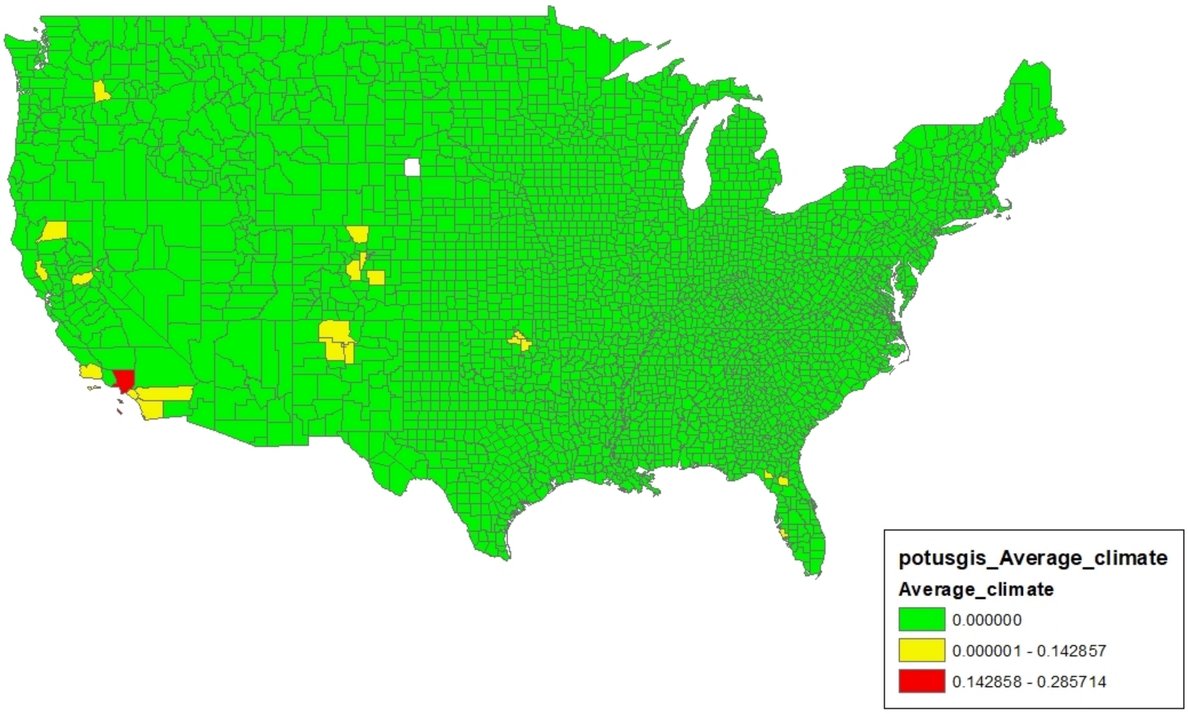
	Climatological			Geophysical			Hydrological			Meteorlogoical		
VARIABLES	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
1.hydro#c.asian %								-0.332**	-0.391**			
								(0.167)	(0.163)			
1.hydro#c.black %								0.0592	0.0495			
								(0.0412)	(0.0414)			
1.hydro#c.hisp %								0.0342	-0.0434			
								(0.0482)	(0.0681)			
1.hydro#c.native %								-0.955***	-1.035***			
								(0.256)	(0.282)			
1.hydro#c.two %								1.706**	2.193***			
								(0.744)	(0.717)			
meteorological										0.00976***	-0.00367	-0.00100
										(0.00197)	(0.00288)	(0.00276)
1.meteor#c.asian %											-0.202***	-0.185***
											(0.0520)	(0.0474)
1.meteor#c.black %											0.0322	0.0304
											(0.0204)	(0.0191)
1.meteor#c.hispanic %											-0.0523***	-0.0624***
											(0.0140)	(0.0142)
1.meteor#c.native %											-0.671***	-0.397**
											(0.223)	(0.157)
1.meteor#c.two %											2.759***	1.915***
											(0.465)	(0.399)
year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Constant	0.645***	0.645***	0.592***	0.645***	0.646***	0.592***	0.645***	0.645***	0.592***	0.645***	0.645***	0.592***
	(0.00628)	(0.00628)	(0.00614)	(0.00628)	(0.00628)	(0.00614)	(0.00627)	(0.00629)	(0.00614)	(0.00626)	(0.00623)	(0.00610)
Observations	21,786	21,786	21,786	21,786	21,786	21,786	21,786	21,786	21,786	21,786	21,786	21,786
R-squared	0.347	0.347	0.384	0.347	0.347	0.383	0.347	0.347	0.384	0.348	0.350	0.385
Number of FIPS	3,114	3,114	3,114	3,114	3,114	3,114	3,114	3,114	3,114	3,114	3,114	3,114

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

3.6.1 Climatological analysis

The POTUS spatial analysis in Figure 23 shows on average which counties have climatological events during a POTUS election year.

Figure 23: POTUS average climatological frequency per FIPS



In model 1, the base model with no interaction between climatological and race and ethnicity, shows the climatological variable has negative statistical significance. With interaction between climate and race in model 2, the climate variable has negative statistical significance and in model 3 no significance.

Without climate interaction with race, model 1, all of the races and ethnicities are statistically significant expect Blacks. Hispanics, Natives, and Two or more tend to statistically significantly vote less in terms of the White population percentage of the total vote. A possible explanations for no statistical significance for Blacks is general lack of political interest because of the history between Blacks and the federal government, voter suppression, ID laws, lack of voter registration with these leading to a higher cost of voting. These same possibilities why Blacks do not vote may explain why Hispanics, Natives, and Two or more are statistically significant and tend to vote less in terms of White population percentage of the total vote. However, these explanations do not explain why Asians are statistically significant and tend to vote more in terms of White population percentage of the total vote during climatic conditions without interactions.

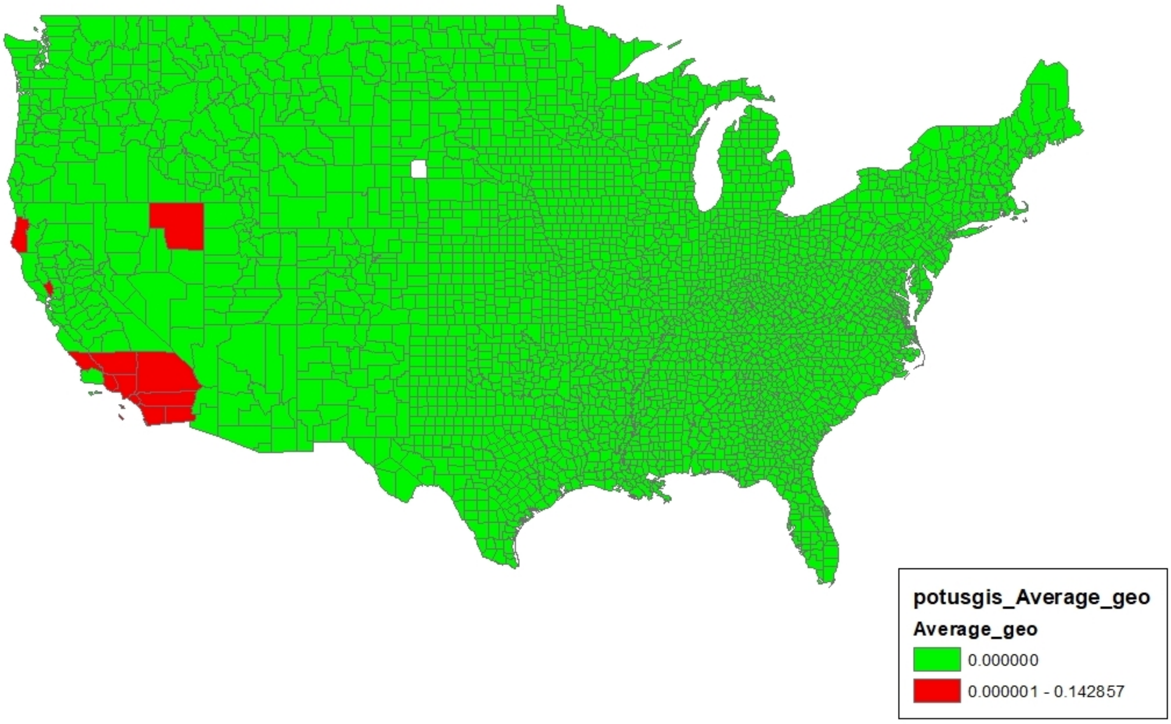
With climate interaction, model 2, Natives are statistically significant and are inclined to vote less terms of the White population percentage of the total vote with no election variables. The other races and ethnic groups have no statistical significance. When election variables are included in model 3, Blacks and Hispanics are statistically significant and are inclined to vote less in terms of the White population percentage of the total vote. Why the change in statistical significance without and with election variables from model 2 to 3 for Natives, Blacks, and Hispanics? This study has no plausible explanation why this anomaly happens.

The election variables in model 3, margin of winning votes, is statistically significant when climatological disasters are interacted with race on the total POTUS vote. The POTUS Democrat vote percentage, accounting for climate and the interaction for climate and race has a statistically significant affect on the total POTUS vote percentage.

3.6.2 Geophysical analysis

The POTUS spatial analysis in Figure 24 shows on average which counties have geophysical events during a POTUS election year.

Figure 24: POTUS average geophysical frequency per FIPS



The geophysical variable only has statistical significance in model 6—geophysical interaction with race and ethnicity and the inclusion of election variables showing that geophysical disasters with election variables included indicate a statistically significant of lower POTUS election turnout because of the disaster.

With no geophysical interaction, model 4, Blacks are the only race which has no statistical significance. All of the remaining race and ethnicities, Asians, Hispanics, Natives, and Two or more, are statistically significant Asians are statistically significant and tend to vote more in terms of the White population percentage of the total vote. Hispanics, Natives, and Two or more are statistically significant less in terms of voting in POTUS elections in terms of the White population percentage of the total vote during geophysical conditions with no geophysical interaction. This follows the same pattern as model 1.

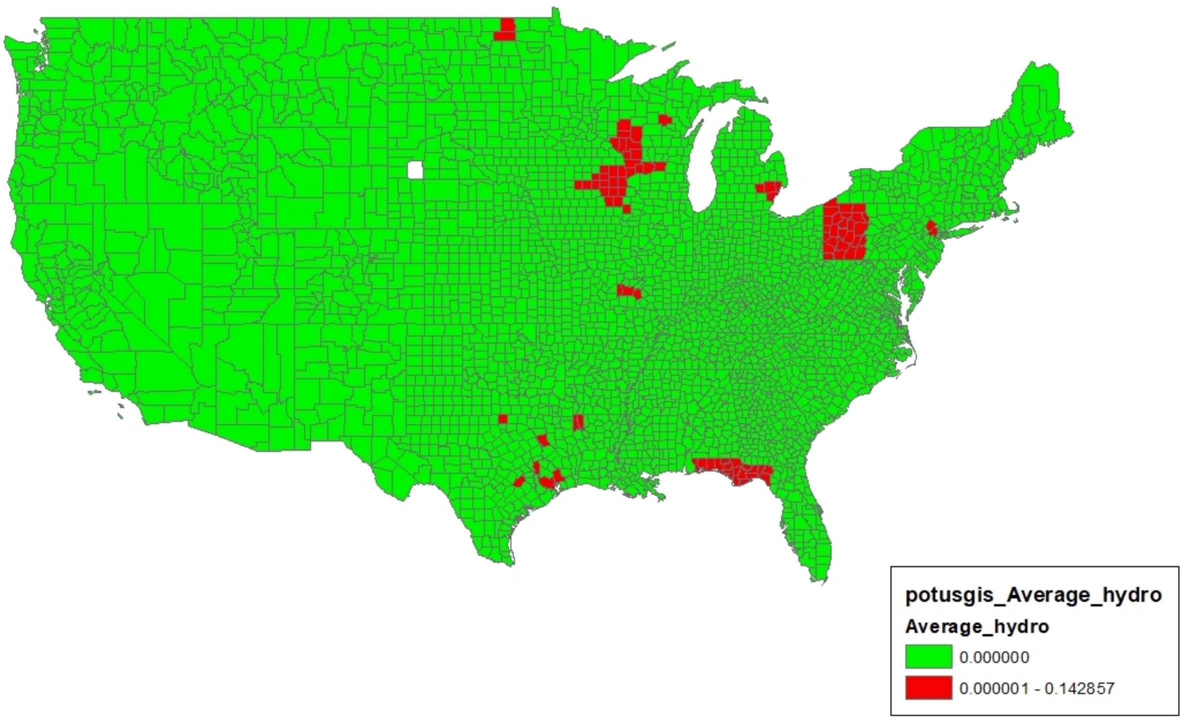
In model 5, with geophysical interaction, Asians are statistically significant and are inclined to vote more in terms of the White population percentage of the total vote with no election variables. Hispanics, with geophysical interaction, are statistically significant and tend to vote less in terms of the White population percentage of the total vote. In model 6, when election variables are included in the model, Blacks and Asians are statistically significant and are inclined to vote more in terms of the White population percentage of the total vote. Hispanics, when election variables are included in the model, are statistically significant and tend to vote less in terms of the White population percentage of the total vote.

The election variables in model 6, POTUS margin of winning votes is statistically significant when geological disasters are interacted with race on the total POTUS vote. The POTUS Democrat vote percentage, accounting for climate and the interaction for geophysical and race has a statistically significant affect on the total POTUS vote percentage.

3.6.3 Hydrological analysis

The POTUS spatial analysis in Figure 25 shows on average which counties have hydrological events during a POTUS election year.

Figure 25: POTUS average hydrological frequency per FIPS



Hydrological disasters are not significant across all three models 7-9, suggesting POTUS election total votes are less in terms hydrological events. Blacks are the only race without statistical significance. Of the remaining races, in model 7, only Asians have statistical significance in voting compared to the White percentage of the total vote. The other races, Hispanics, Native, and Two-per with no interaction with hydrological vote significantly less than Whites in terms of the population percentage. This follows the same no interaction pattern found in models 1 and 4.

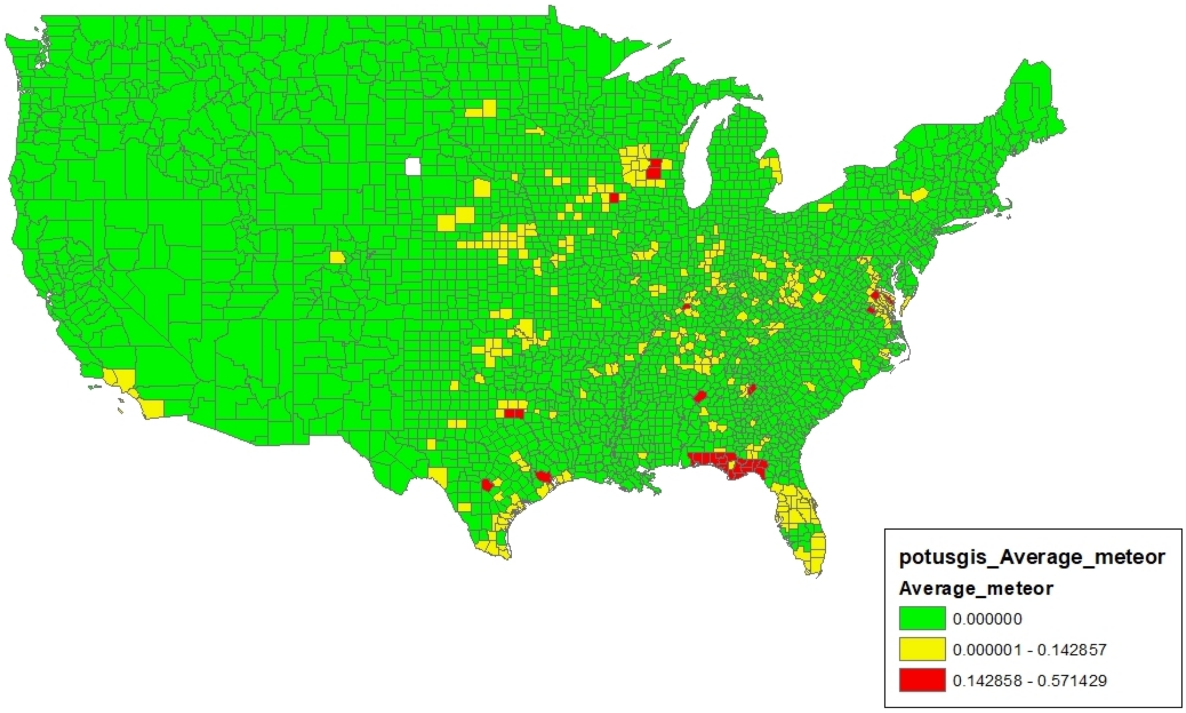
Models 8 and 9 have similar patterns, with interaction between hydrological and race, Asians and Natives are statistically significant and tend to vote less in terms of the White population percentage of the total vote. Two or more when interacting with the hydrological variable, with and without the election variables, tend to vote more in terms of the White population percentage of the total vote.

The election variables in model 9, margin of winning votes, is statistically significant when hydrological disasters are interacted with race on the total POTUS vote. The POTUS Democrat vote percentage, accounting for hydrological disasters and the interaction for hydrological and race has a statistically significant affect on the total POTUS Democrat vote percentage.

3.6.4 Meteorological

The POTUS spatial analysis in Figure 26 shows on average which counties have meteorological events during a POTUS election year.

Figure 26: POTUS average meteorological frequency per FIPS



The meteorological variable has statistical significance only when no interaction with race occurs as in Model 10. When interacted with race or interaction with race and the inclusion of election variables, meteorological has no statistical significance.

With no interaction with meteorological, model 10, only Asians have a statistical significance and are inclined to vote more than Whites in terms of the population percentage. Blacks have no statistical significance with no interaction and the remaining races, Hispanic, Natives, and Two or more, are statistically significant and are inclined to vote less than Whites in terms of the total population. Again, this follows the same pattern for POTUS elections across models 1, 4, and 7.

A similar pattern occurs in models 11 and 12, race with interaction. Asians, Hispanics, and Natives are statistically significant and tend to vote less than Whites in terms of the total population. Two or more are statistically significant and are inclined to vote more than Whites in terms of the total population.

The election variables in model 12, margin of winning votes, is statistically significant when meteorological disasters interact with race on the total POTUS vote. The POTUS Democrat vote percentage, accounting for meteorological and the interaction for meteorological and race has a statistically significant affect on the total POTUS Democrat vote percentage when compared to the total POTUS vote percentage.

3.6.5 POTUS residual analysis

The residual scatterplots, models 3, 6, 9, and 12, show a symmetric consistency in the models with clustering less than 1 with one consistent outlier in all four disaster categories, 48301 Loving county, TX in the years 2000 and 2004. All other FIPS residuals in the four disaster categories are less than 1. The reason for this residual outlier is an election data entry error from the original data source. 48301 had a total population of 52 and 45 people in the years 2000 and 2004, respectfully, aged twenty and upwards. The election data records a POTUS vote total of 156 and 80. Because the DV, $y1 = \frac{\text{potus total vote}}{\text{potential population}}$, and the denominator includes the white population, the residual becomes an outlier.

Figure 27: POTUS climatological residuals scatterplot

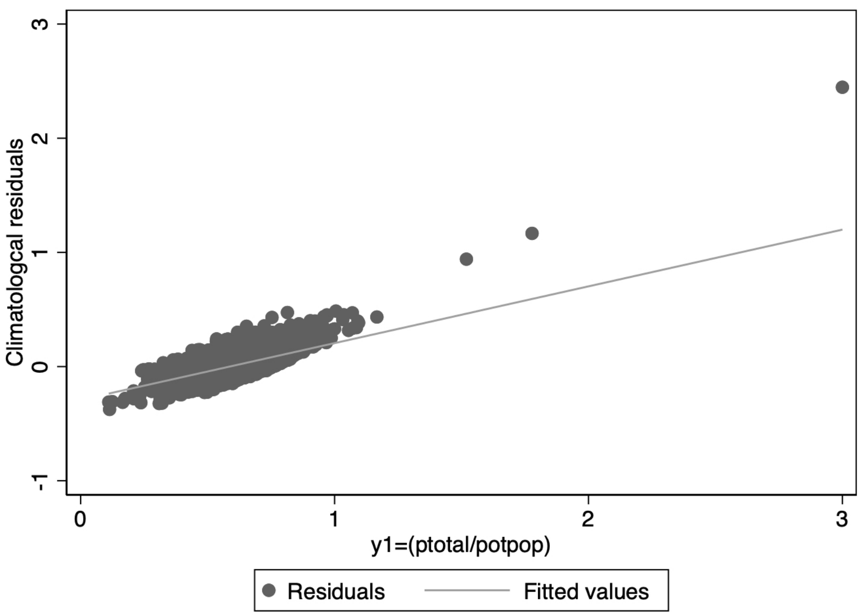


Figure 28: POTUS geophysical residuals scatterplot

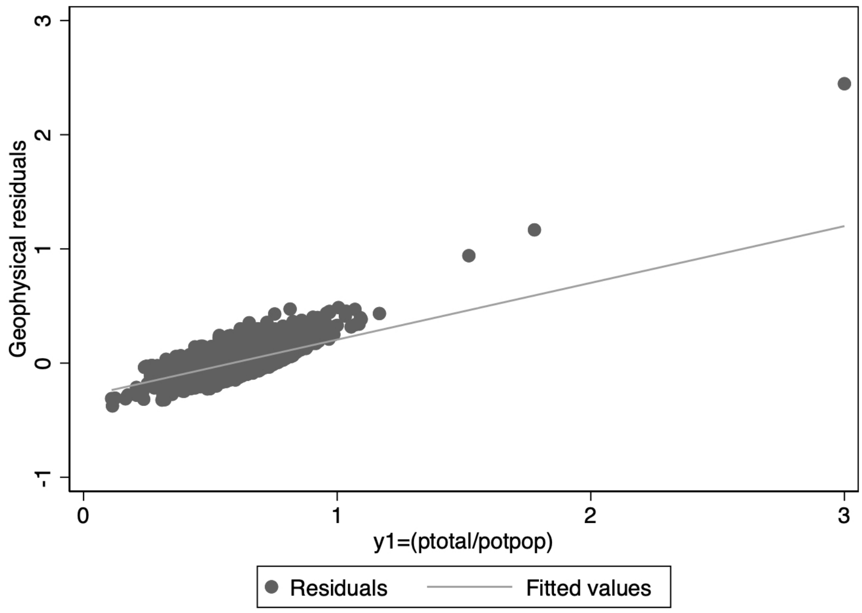


Figure 29: POTUS hydrological residuals scatterplot

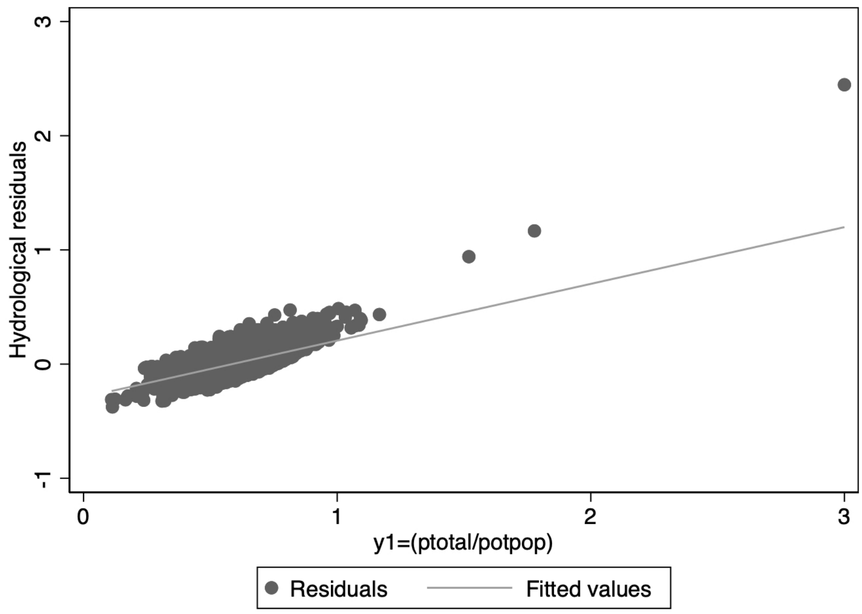
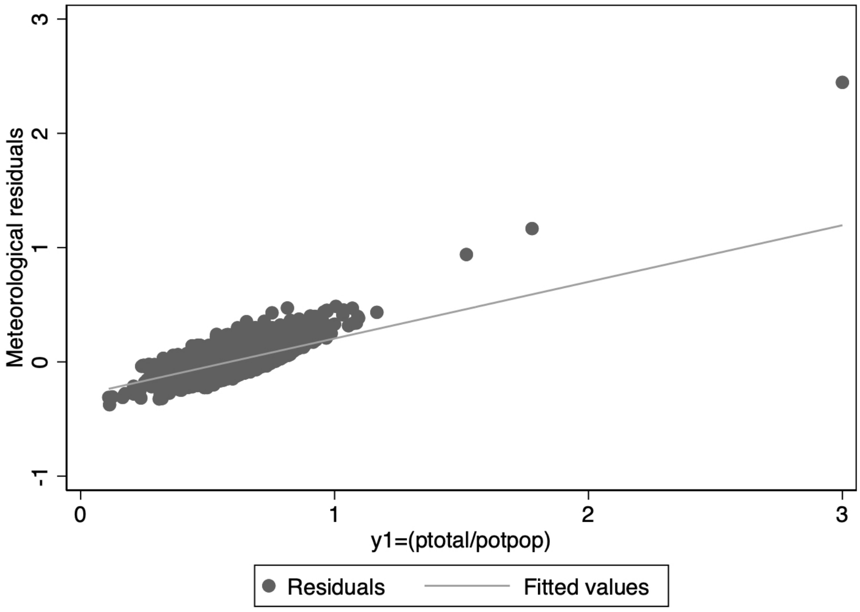


Figure 30: POTUS meteorological residuals scatterplot



3.6.6 POTUS election conclusions

All four disasters—climatological, geophysical, hydrological, and meteorological—report similar results. Asians consistently vote more and Hispanics, Natives, and Two or more routinely vote less.

With interaction between the disasters and the Asians, geophysical interaction results in Asians vote more in terms of Whites, but under hydrological and meteorological circumstances Asians statistically tend to vote less in terms of the White population of the total vote. In three events —climatological, geophysical, and meteorological —Hispanics are statistically significant and to tend to vote less than Whites in terms of the total population. Natives are statistically significant in tending to vote less than Whites in terms of the total population when living under hydrological and meteorological conditions with interaction. Two or more races are statistically significantly tend to vote more than Whites in terms of the total population when living under hydrological and meteorological disasters.

Natural disasters do impact minority voters but it depends on the minority group and some of these consequences are statistically significant but only with regard to the minority impacted group. None of the four disaster categories are statistically significant and affect all—Asians, Blacks, Hispanics, Native Americans, and Two or more—in equal or statistically significance under the same disaster. Thus, the research questions are only partially answered under these models for POTUS elections.

Figure 31: POTUS average DV, y1

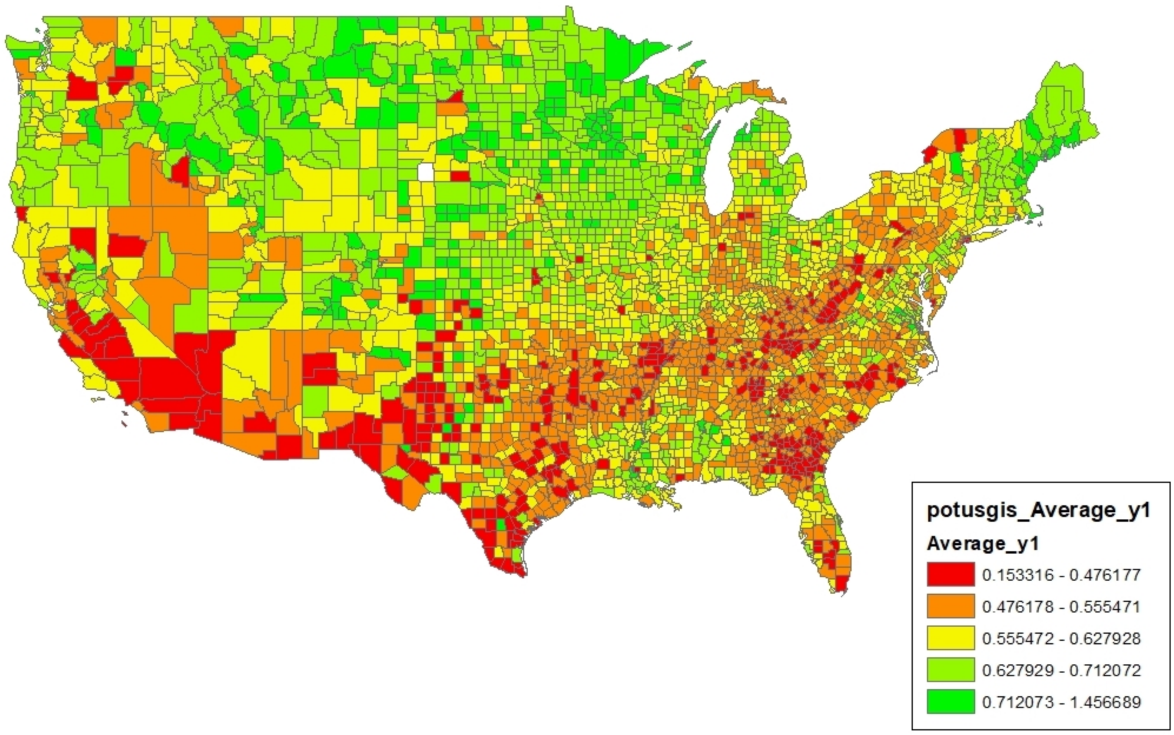


Figure 31 illustrates the average minority voter turnout overtime for FIPS having the four natural disaster categories. Spatially, this map shows where minority races do not vote and many of these areas are where natural disasters occur in the years of a POTUS election.

3.7 Senate election analysis

Senate elections occur every two years with $\frac{1}{3}$ of the Senate up for election as mandated by the Constitution. All of the models in the Senate analysis compare the election turnout to Whites as these models focuses upon Asians, Blacks, Hispanic ethnicity, Natives, and Two races or more as categorized by the US Census Bureau.

Table 19 displays all of the linear regression results of the disasters and Senate elections for the years in the analysis. This study uses three models per each disaster category. β_1 is a disaster dummy variable coded $\beta_1 = 1$ if the disaster occurred and $\beta_1 = 0$ otherwise in each of the disaster categories. The calculation for the DV is $y1 = \frac{stotal}{pottot}$ where the numerator stotal represents the Senate race total election votes and the denominator represents the sum of the potential total voters in the county. All of the DVs follow the same format with the only change in the numerator for each elected office total votes. The denominator never changes. The Senate regression results follow in Table 19.

Models 1, 4, 7, and 10 use Equation (23). β_1 is a disaster dummy variable coded $\beta_1 = 1$ if the disaster occurred and $\beta_1 = 0$ otherwise. The purpose of Equation (23) determines if disasters have any impact at all on the individual races and ethnicities and is the most basic format. Equation (23) has an underlying assumption that disasters do not affect minority voter turnout.

$$y1 = \alpha + \beta_1 \text{disaster} + \beta_2 \text{race} + \beta_3 (\text{individual year}) + \epsilon \tag{23}$$

Models 2, 5, 8, and 11 follow the follow format of Equation (23) but includes an interaction variable between the disaster and the races and tests the assumption that natural disasters do impact the individual minority groups.

$$y1 = \alpha + \beta_1 \text{disaster} + \beta_2 (\text{disaster } \times \text{race}) + \beta_3 (\text{individual year}) + \epsilon \tag{24}$$

Models 3, 6, 9, and 12 include the format of Equation (24) but adds two election variables resulting in Equation (25). The election data variables are the margin of winning vote percentage and the Democrat party percentage of the total votes. The winning vote percentage does not differentiate between parties or candidates, just what the winning percentage was of the total votes cast. The two reasons why it does not matter if this study used the Democratic party or Republican party as independent variables: First, because if both variables were in the regression one would have been dropped because of collinearity and second, because the US has two major parties, Democrats and Republicans, and a win or loss by one party is the inverse of the other at election time.

$$y1 = \alpha + \beta_! \text{disaster} + \beta_2(\text{disaster } \times \text{race}) + \beta_3(\text{individual year}) + \beta_4(\text{election data}) + \epsilon \quad (25)$$

The Senate regression results follow in Table 19.

Table 19: Senate disaster regression results
DV vote turnout

	Climatological			Geophysical			Hydrological			Meteorlogoical		
VARIABLES	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
climatological	-0.0203***	0.0232**	0.0335***									
	(0.00700)	(0.00999)	(0.0105)									
senate margin			1.33e-07***			1.36e-07***			1.30e-07***			1.28e-07***
			(4.10e-08)			(3.99e-08)			(4.21e-08)			(4.21e-08)
senate dem %			0.0217***			0.0216***			0.0215***			0.0215***
			(0.00526)			(0.00526)			(0.00526)			(0.00526)
asian %	0.524***	0.525***	0.422***	0.525***	0.532***	0.430***	0.524***	0.526***	0.423***	0.519***	0.533***	0.430***
	(0.0976)	(0.0979)	(0.0970)	(0.0978)	(0.0984)	(0.0978)	(0.0976)	(0.0975)	(0.0966)	(0.0975)	(0.0996)	(0.0986)
black %	-0.0291	-0.0293	-0.0465	-0.0290	-0.0295	-0.0469	-0.0290	-0.0287	-0.0456	-0.0298	-0.0323	-0.0492
	(0.0590)	(0.0591)	(0.0577)	(0.0590)	(0.0591)	(0.0577)	(0.0591)	(0.0591)	(0.0577)	(0.0590)	(0.0591)	(0.0577)
hispanic %	-0.562***	-0.562***	-0.560***	-0.562***	-0.563***	-0.561***	-0.562***	-0.562***	-0.560***	-0.563***	-0.562***	-0.561***
	(0.0319)	(0.0319)	(0.0316)	(0.0320)	(0.0320)	(0.0318)	(0.0319)	(0.0319)	(0.0317)	(0.0319)	(0.0318)	(0.0316)
native %	-1.268***	-1.269***	-1.238***	-1.268***	-1.267***	-1.236***	-1.266***	-1.265***	-1.235***	-1.264***	-1.246***	-1.215***
	(0.142)	(0.142)	(0.138)	(0.142)	(0.142)	(0.138)	(0.142)	(0.142)	(0.138)	(0.142)	(0.141)	(0.136)
two %	-0.597***	-0.595***	-0.634***	-0.598***	-0.599***	-0.637***	-0.598***	-0.597***	-0.636***	-0.601***	-0.668***	-0.706***
	(0.0840)	(0.0839)	(0.0787)	(0.0840)	(0.0839)	(0.0788)	(0.0839)	(0.0843)	(0.0792)	(0.0844)	(0.0882)	(0.0827)
1.climate#c.asian %		0.142*	0.189**									
		(0.0802)	(0.0819)									
1.climate#c.black %		-0.0738	-0.0590									
		(0.0588)	(0.0718)									
1.climate#c.hispanic %		-0.0742***	-0.0754**									
		(0.0281)	(0.0317)									
1.climate#c.native %		-0.207	-0.249									
		(0.169)	(0.177)									
1.climate#c.two %		-2.549***	-3.562***									
		(0.878)	(0.858)									
geophysical				0.00647	0.0201**	-0.0244						
				(0.00839)	(0.0102)	(0.0227)						
1.geo#c.asian %					0.475***	0.673***						
					(0.0981)	(0.181)						
1.geo#c.black %					-0.369***	0.205						
					(0.102)	(0.228)						
1.geo#c.hispanic%					-0.136***	-0.0998***						
					(0.0133)	(0.0238)						
1.geo#c.native %					0.616***	1.409***						
					(0.217)	(0.487)						
1.geo#c.two %					-0.755***	-0.953***						
					(0.172)	(0.276)						
hydrological							0.00849*	0.0236***	0.0240***			
							(0.00488)	(0.00626)	(0.00625)			
1.hydro#c.asian %								-0.122	-0.0569			

Continued on next page

Table 19 – continued from previous page

	Climatological			Geophysical			Hydrological			Meteorlogoical		
VARIABLES	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
								(0.0868)	(0.119)			
1.hydro#c.black %								-0.104	-0.102			
								(0.0769)	(0.0757)			
1.hydro#c.hispanic %								-0.0274*	-0.0189			
								(0.0147)	(0.0161)			
1.hydro#c.native %								-0.917***	-0.806***			
								(0.272)	(0.266)			
1.hydro#c.two %								0.436	0.150			
								(0.379)	(0.497)			
meteorological										0.00828***	-0.00538	-0.00539
										(0.00242)	(0.00416)	(0.00416)
1.meteor#c.asian %											-0.216***	-0.205***
											(0.0477)	(0.0463)
1.meteor#c.black %											0.0335	0.0309
											(0.0266)	(0.0263)
1.meteor#c.hispanic %											-0.0317**	-0.0330**
											(0.0148)	(0.0148)
1.meteor#c.native %											-0.547**	-0.534**
											(0.248)	(0.242)
1.meteor#c.two %											2.461***	2.455***
											(0.579)	(0.573)
year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Constant	0.480***	0.480***	0.470***	0.480***	0.480***	0.470***	0.480***	0.480***	0.470***	0.480***	0.480***	0.470***
	(0.00558)	(0.00558)	(0.00640)	(0.00558)	(0.00558)	(0.00641)	(0.00558)	(0.00558)	(0.00640)	(0.00558)	(0.00557)	(0.00640)
Observations	28,860	28,860	28,860	28,860	28,860	28,860	28,860	28,860	28,860	28,860	28,860	28,860
R-squared	0.651	0.651	0.652	0.651	0.651	0.652	0.651	0.651	0.652	0.651	0.652	0.653
Number of FIPS	3,113	3,113	3,113	3,113	3,113	3,113	3,113	3,113	3,113	3,113	3,113	3,113

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

3.7.1 Climatological analysis

Figure 32: Senate average climatological frequency per FIPS

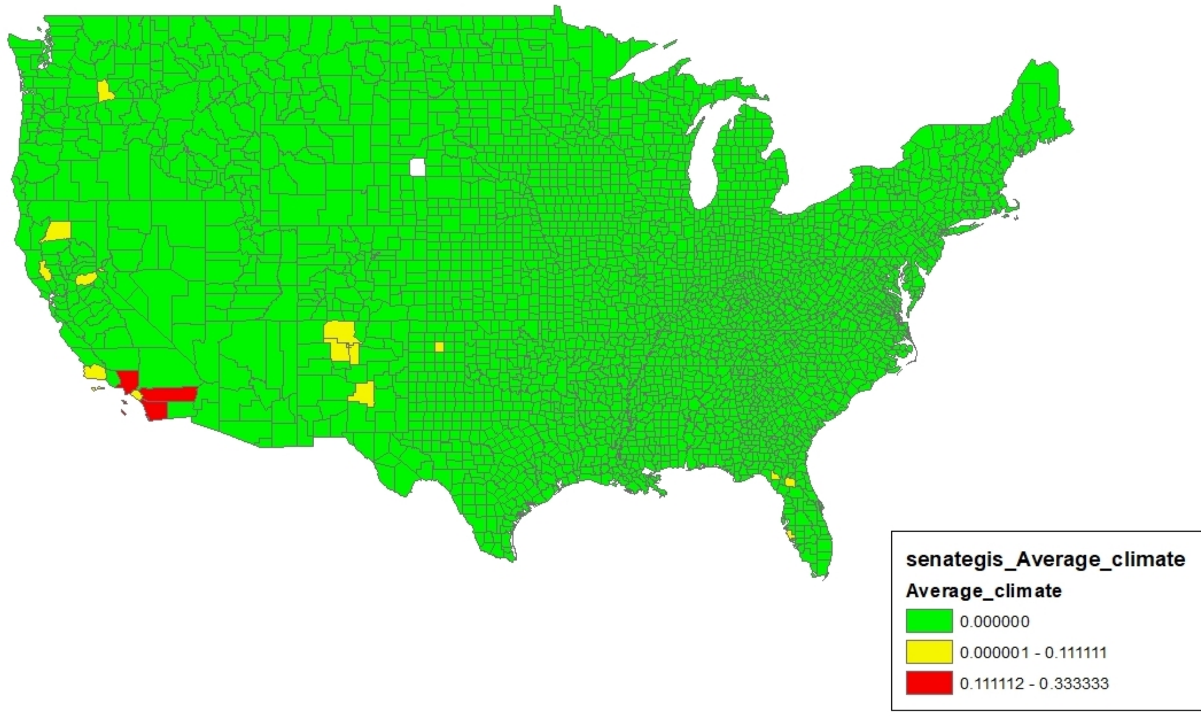


Figure 32 shows on average which counties have climatological events during a Senate election year.

In model 1, the climatological variable is statistically significant with a negative sign indicating under climatological conditions without interaction minorities will vote less. Asians without interaction with the disaster statistically significantly vote more when compared to Whites in terms of the total population in all four disaster models, 1, 4, 7, and 10.

Each of the races and ethnicities, with no interaction in model 1, are statistically significant with Blacks the only exception. Without interaction Asians tend to statistically significantly vote more in terms of population percentage than Whites and Hispanics, Natives, and Two-per are statistically significant in voting less in terms of total population percentage than Whites.

With interaction between climate and race, models 2 and 3, show similar results. Climatological disasters are statistically significant with a disaster interaction between Asians, Hispanics, and Two or more. Asians are statistically significant and tend to vote more in terms of total population than Whites. Hispanics and Two or more are statistically significant and tend to vote less in terms of White population percentage of the total vote.

The election variables in model 3, margin of winning votes, are statistically significant when climatological disasters are interacted with race on the total Senate vote. The Senate Democrat vote percentage, accounting for climatological disasters and the interaction for climatological disasters and race and ethnicity has a statistically significant affect on the total Senate vote percentage.

3.7.2 Geophysical analysis

Figure 33: Senate average geophysical frequency per FIPS

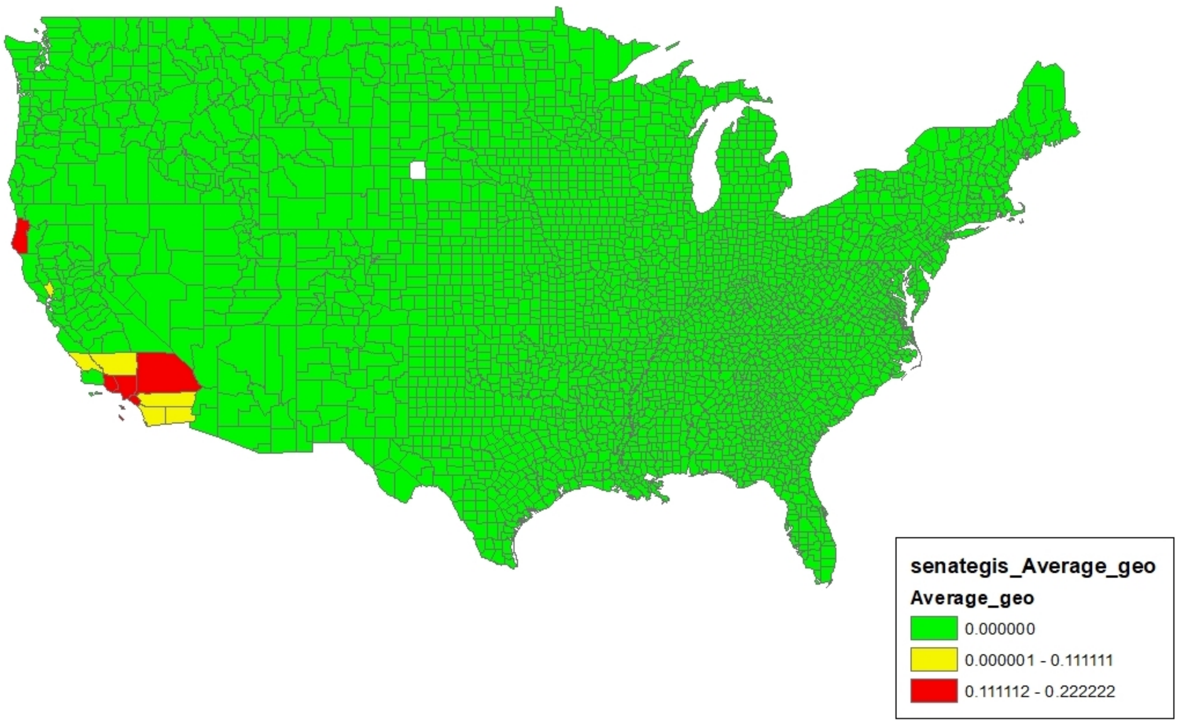


Figure 33 shows on average which counties have geophysical events during a Senate election year.

The geophysical variable has no significance in model 4, no interaction with the races. In model 5 the geophysical variable has statistical significance when interacting with race but no significance when election variables are included in model 6.

All of the race variables in model 4 are statistically significant and follow the same pattern as model 1. Asians tend to vote more that Whites in terms of total population. Hispanics, Natives and Two or more are statistically significant and tend to vote less than Whites in terms of total population.

In models 5 and 6, interaction with races, the geophysical variable is statistically significant and has positive impact on the Senate total vote only in model 5. In model 5, the race interaction with the geophysical variable has all five race groups as statistically significant. Asians and Natives tend to vote more than Whites in terms of the total population and Blacks, Hispanics and Two or more tend to vote less with statistical significance. This is the only model of the twelve Senate models that Blacks have any statistical significance. Model 6 follows the same race results pattern except for Blacks who are not statistically significant.

The election variables in model 6, margin of winning votes, is statistically significant when geological disasters are interacted with race on the total Senate vote. The Senate Democrat vote percentage, accounting for climate and the interaction for climate and race has a statistical significant affect on the total Senate vote percentage.

3.7.3 Hydrological analysis

Figure 34: Senate average hydrological frequency per FIPS

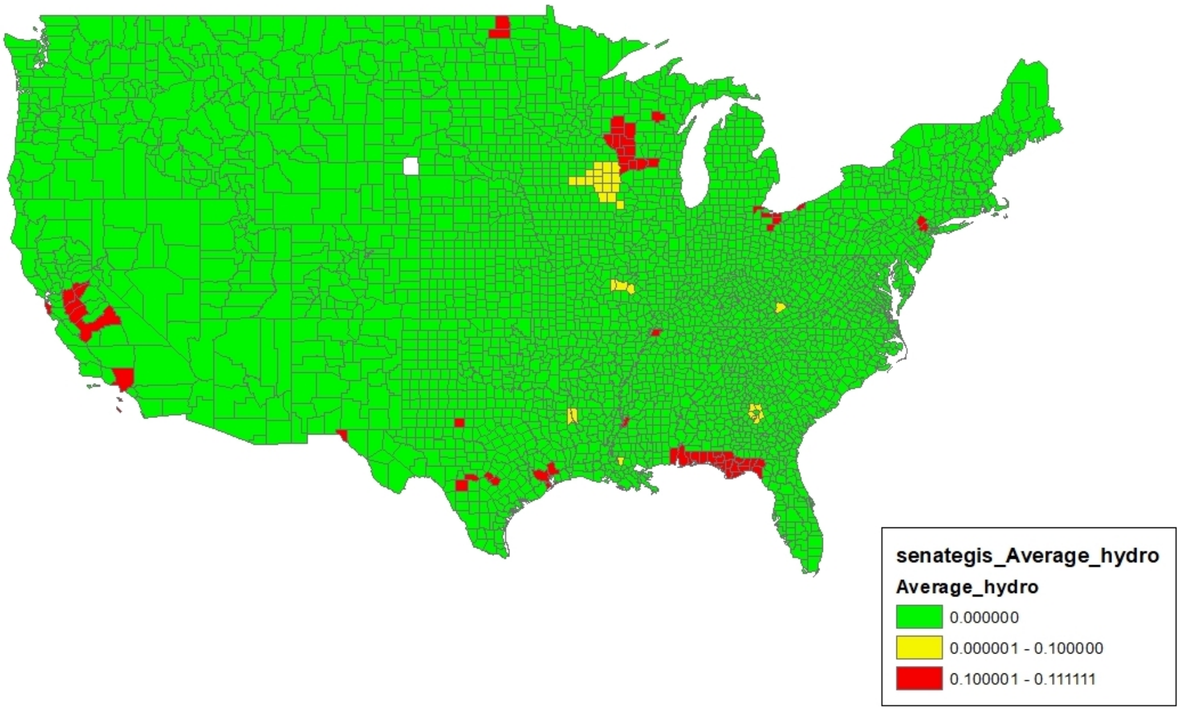


Figure 34 shows on average which counties have hydrological events during a Senate election year.

Hydrological disasters are significant across all three models 7-9 implying hydrological disasters are statistically significant with minority voters causing them to tend to vote more than Whites in terms of the total population. Without an interaction, in model 7, Blacks are the only race and ethnicity without statistical significance. Of the remaining races, only Asians have more statistical significance in voting compared to the White percentage of the total vote. The other races, Hispanics, Native, and Two-per with no interaction with the hydrological variable, vote significantly less than Whites in terms of the population percentage. This pattern follows models 1 and 4.

With interaction between hydrological and race and ethnicity in model 8, only Hispanics and Natives are statistically significant and tend to vote less in terms of the White population percentage of the total vote. When including the election variables in model 9

Natives are statistically significant and tend to vote less in terms of the white population percentage the total vote.

The election variables in model 9, margin of winning votes, is statistically significant when climatological disasters are interacted with race and ethnicity on the total Senate vote. The Senate Democrat vote percentage, accounting for hydrological interaction with race and ethnicity has a statistically significant affect on the total Senate Democrat vote percentage.

3.7.4 Meteorological

Figure 35: Senate average meteorological frequency per FIPS

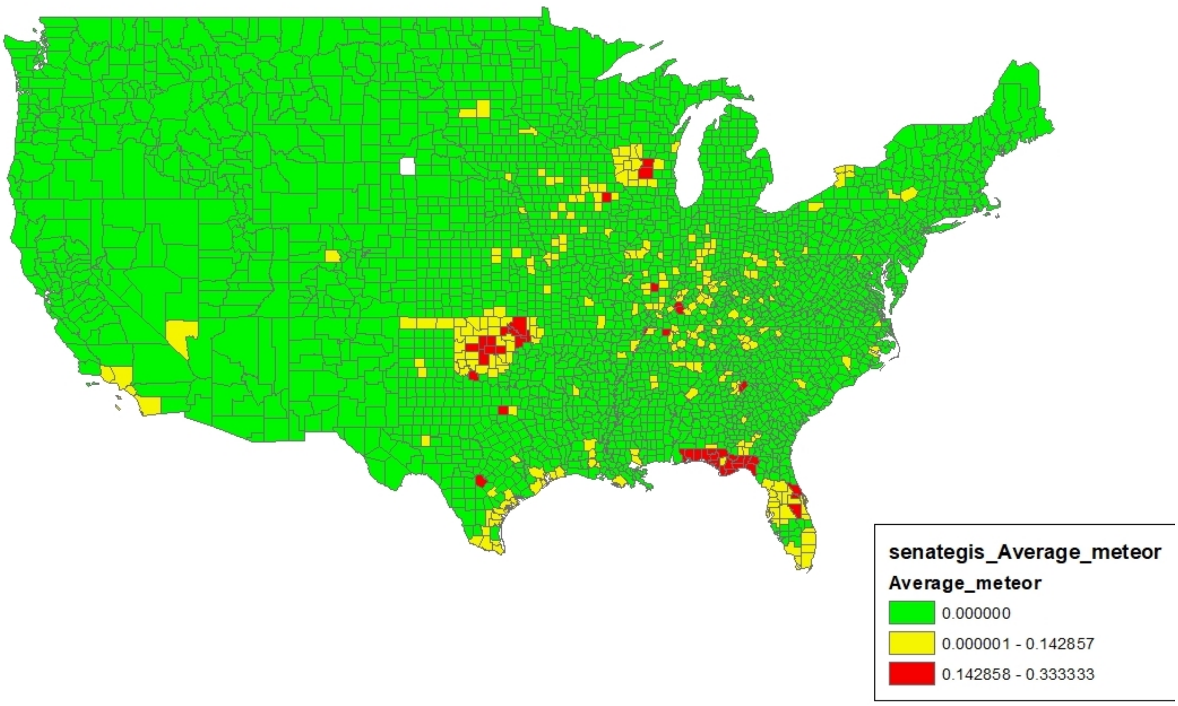


Figure 35 shows on average which counties have meteorological events during a Senate election year.

The meteorological variable has statistical significance only when no interaction with race occurs as in model 10. When interacted with race and the inclusion of election variables meteor has no statistical significance in models 11 and 12.

The pattern for race participation in elections have similarities in all three models 10, 11, and 12. With no interaction meteorological disasters Asians have a statistical significance and are inclined to vote more than Whites in terms of the total population percentage. Hispanic, Natives, and Two or more are statistically significant and with meteorological interaction vote less than Whites in terms of the total population percentage. Blacks have no statistical significance in all three models.

In models 11 and 12, meteorological interacted with race, Asians, Hispanics, and Natives are statistically significant and vote less than Whites in terms of the total population percentage. Two or more people are statistically significant and tend to vote more than Whites in terms of the total population percentage.

The election variables in model 12, margin of winning votes, is statistically significant when meteorological disasters interact with race on the total Senate vote. The Senate Democrat vote percentage, accounting for meteor and the interaction for meteor and race has a statistically significant affect on the total Senate Democrat vote percentage.

3.7.5 Senate residual analysis

The residual scatterplots, models 3, 6, 9, and 12, show a symmetric consistency in the models with clustering less than 1 with one consistent outlier in all four disaster categories, 48301 Loving county, TX in the year 2000. All other FIPS residuals in the four disaster categories are less than 1. The reason for this residual outlier is an election data entry error from the original data source. 48301 had a total population of 52 in the years 2000 aged twenty and upwards. The election data records a Senate vote total of 140. Because the DV, $y1 = \frac{\text{senate total vote}}{\text{potential population}}$, and the denominator includes the white population, the residual becomes an outlier.

Figure 36: Senate climatological residuals scatterplot

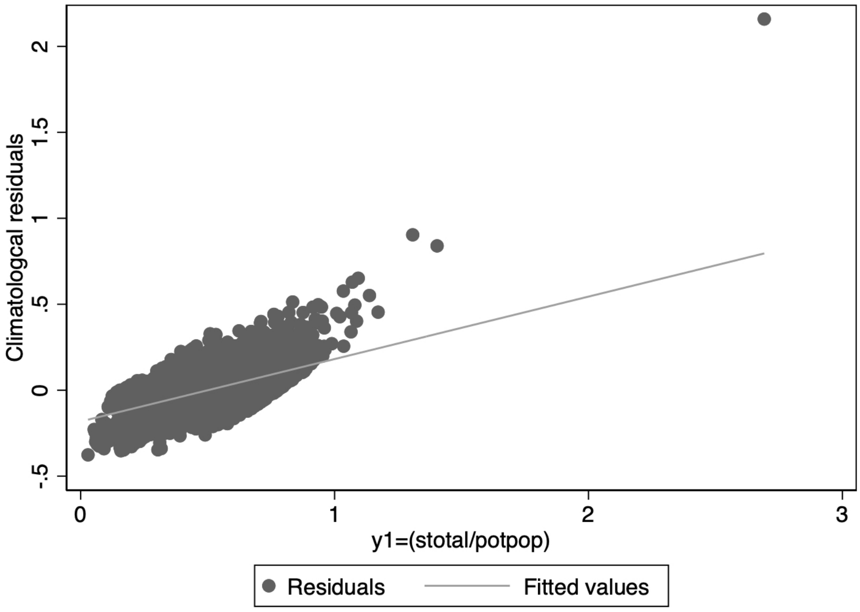
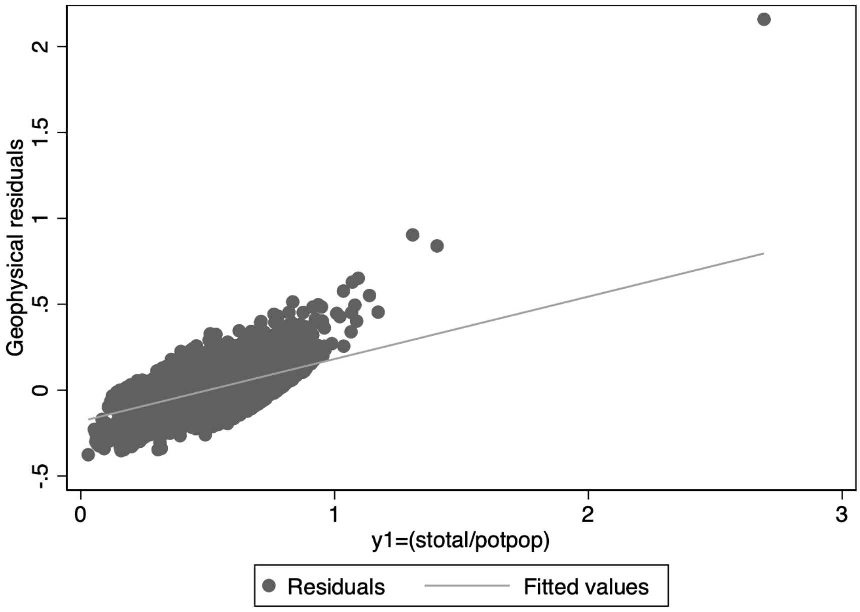


Figure 37: Senate geophysical residuals scatterplot



x

Figure 38: Senate hydrological residuals scatterplot

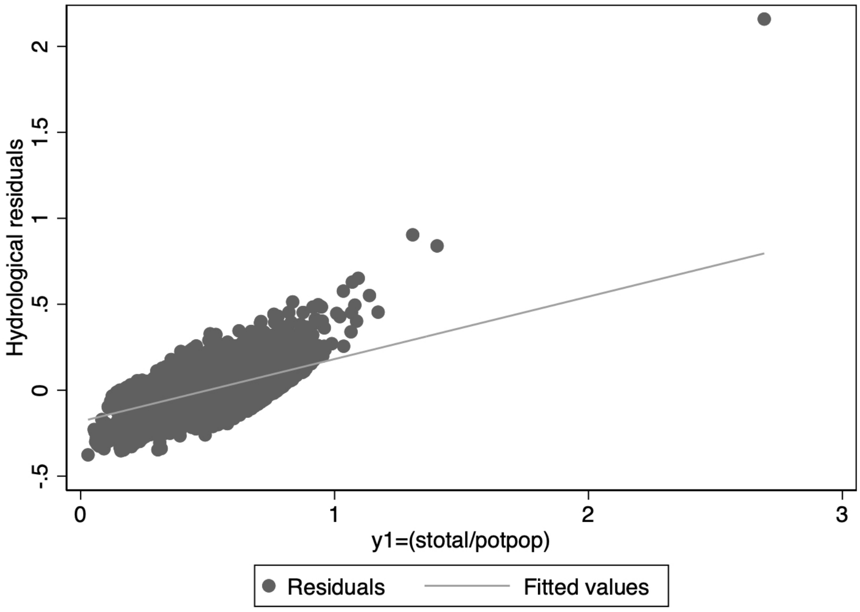
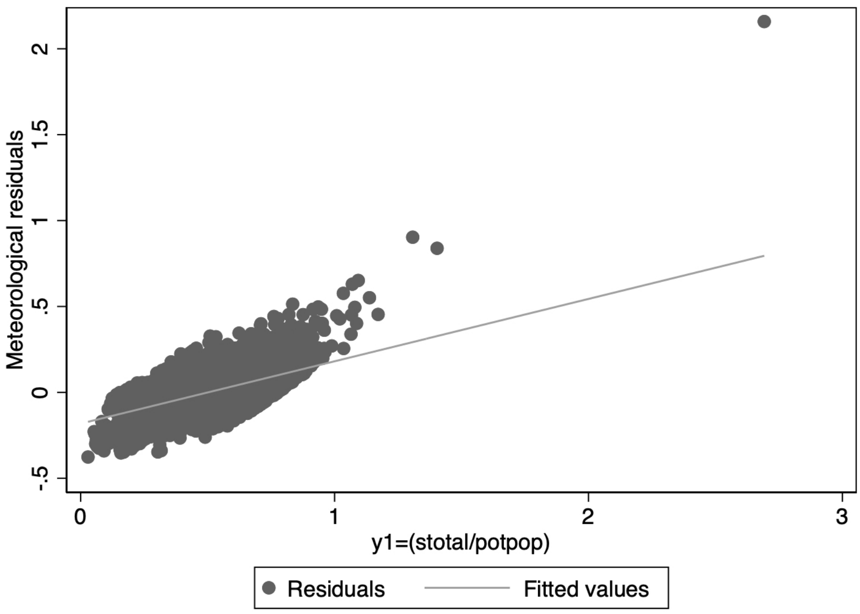


Figure 39: Senate meteorological residuals scatterplot



3.7.6 Senate election conclusions

In the Senate election regression results a few races are fairly consistent in terms of the disasters. Hispanics are consistent in voting less than Whites in terms of the total population across all the models except for model 9, disaster interaction without election variables. Two or more have mixed results with voting less in climatological and geophysical disasters and voting more in meteorological disasters. Asians are consistent in voting statistically more than Whites in terms of total population under climatological and geophysical models, but disappear under hydrological disasters with interaction in both models 8 and 9. Asians are statistically significant in voting less when compared to Whites when interacted with meteor with and without election variables.

Natural disasters do impact minority voters but it depends on the minority group and some of these consequences are statistically significant but only with regard to the minority impacted group. None of the four disaster categories statistically significantly affect all—Asians, Blacks, Hispanics, Native Americans, and Two or more—in equal or statistically significance under the same disaster.

Figure 40: Senate average DV, y1

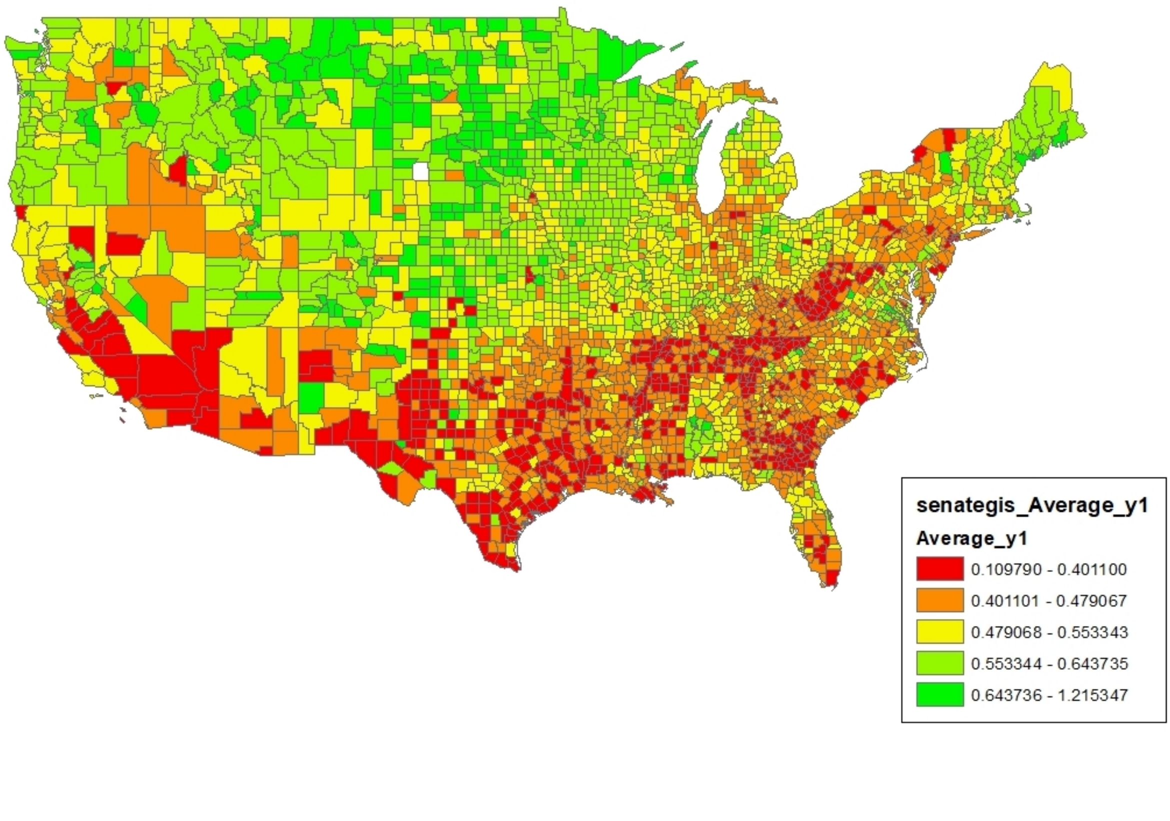


Figure 40 illustrates the average minority voter turnout overtime for FIPS having the four natural disaster categories. Spatially, this map shows where minority races do not vote and many of these areas are where natural disasters occur in the years of a Senate election.

4 Discussion and conclusions

This study attempts to answer the following research questions.

1. Which natural disasters have a statistically significant effect on minority voter turnout?
2. Which natural disasters have a statistical significance upon the four major US elections, House, Senate, POTUS, and governor?

Using the results from this analysis the answer to the first question has mixed results. Natural disasters do have statistical significance on minority voter turnout but it depends on the types of disaster, election, and minority group. This suggests in terms of the disasters that time appears as an exogenous factor and the EM-DAT definition for a climatological disaster shows this data dilemma. A climatological disaster is a "hazard caused by long-lived, meso- to macro-scale atmospheric processes ranging from intra-seasonal to multi-decadal climate variability," Table 2 Page 21. An extended timeline causes the climatological disaster because the start of a climate disaster may occur in t_0 and may last till t_5 where t represents years. EM-DAT only registers the climatological disaster at the end of the time and not the recurrence of the disaster every year from t_0 to t_5 but only in t_5. This recording over time is not reflected in the regressions because of the lack of information in the EM-DAT data set. Climatological disasters thus have "fuzzy" starting and ending timelines along with frequencies. All other disasters have a defined starting and ending point and without this time measurement, climatological events make their regression results the most difficult to interpret and for reporting government officials. This study shows only 12 climatological disaster for the time period, 1990-2016. This makes for a very small sample size in terms of climatological frequencies and the number of both FIPS and elections.

In terms of elections and races climatological disasters only figured in Asians and House, POTUS, and Senate elections, Blacks in Governor and POTUS elections, Hispanics in all four elections, Natives in Governor and POTUS elections, and Two or more in Senate elections. Climatological events appears in Blacks, Hispanics, and Natives in governor elections. Geophysical events impacts Asian voters in House, POTUS, and Senate elections, Blacks in Governor, POTUS, and Senate elections, Hispanics in all four elections, Natives in governor and Senate elections, and Two or more races in Governor and Senate elections.

The model does not explain how minorities living together in a location experiencing climatological disasters have such a difference in voting behavior. The disaster includes everyone so a possible explanation must come from Equation (1) Page 6 the C variable or the cost of voting for a particular minority group.

For example, Natives with climatological interaction vote significantly less compared to Whites in terms of the potential population percentage in a governor's and POTUS election. However, they have no significance in a House or Senate election and House election which run concurrently with POTUS elections and oftentimes a Senate election. This study cannot address why these election differences except to note they occur.

Geophysical earthquakes have a starting and ending time and date so everyone knows when the disaster occurs. Scientists measure the intensity of earthquakes and their frequency. Hydrological and meteorological events follow this same pattern as geophysical disasters. Because of this "quietness" by climatological disasters, many minority voters are not directly impacted by the "quietness." Geophysical, hydrological, and meteorological disasters are "noisy," short-term, and attracts more attention both in terms of individual lives and news media. Because of the "noisiness" of the greater impact upon individual voters this study shows the mixed results among the minority groups.

Hydrological events, i.e., flooding, are the result of some occurrence that affect surface or subsurface water. At the state level governors have some policy impact in terms of decisions. Of the two, climatological and hydrological, the one that affects voters more directly are hydrological disasters, i.e., flooding. In fact, many floods are known they are coming downstream providing citizens with some time to prepare. Governors may enlist the aid of the National Guard to help with rescue and sandbagging to prevent further flooding. Because climatological disasters, i.e., drought, are beyond the control of a governor, climatological disasters may not have salience and other state political issues may have more impact than the disaster in an election. This study cannot answer if such an assumption has validity, no matter how plausible. The other elections are federal so the policy decision impacting voters are more national than local.

Of the 48 regressions Asians are affected in $\frac{1}{4}$ of the regressions. Only only one House hydrological disasters has an anomaly, model 8 without the election variables, Asians are statistically significant but with election variables are not statistically significant. Why this peculiarity happens the models cannot explain. In all the other 11 elections, both the models without election variables and with election variables, the Asian minorities are statistically significant. Asians and Hispanics are the racial groups that have the most statistical significance within these model's frameworks.

Blacks only have statistical significance in 6 of the 48 regressions for Black voters: governor and climatological, geophysical and meteorological with and without election variables, POTUS and climatological and geophysical both with election variables, and Senate and geophysical without election variables. Why Blacks have this statistically significant pattern of with and without election variables seems an oddity. There are some possible answers for the lack of Black statistical significance regarding Black voter turnout in the majority of these sampled elections with a lack of political engagement by Black voters for House and Senate candidates so the disaster does not matter. This disengagement may come from no interest in and from the candidates or lack of voter information. Yet, that does not explain why Blacks would engage with POTUS and governor elections. Thus, natural disasters do affect Black election turnout but depends on the type of disaster and election.

The US Census Bureau does not consider Hispanics as a racial group but an ethnic group. However, this study considers Hispanics as a race. Hispanics are statistically significant in nearly every disaster category and election with the exception of POTUS elections without election variables in climatological disasters without election variables and hydrological disasters, Senate elections with a hydrological disaster and no election variables. In 15 of the 48 regressions, 14 regressions show statistical significance of Hispanics tending to vote less than Whites in terms of the total population. The only exception is House elections with a hydrological disaster Hispanics are statistically significantly and tend to vote more than Whites in terms of population percentage. This positive statistical significance appears in the model 8 without the election variables. This study cannot explain why hydrological disasters would prompt such behavior.

Governor and POTUS elections with climatological disasters, Natives vote statistically significantly less with and without election variables and less without election variables in POTUS elections. With geophysical disasters Natives tend to vote statistically significantly more than Whites in total population percentage in Senate and governor elections. In all four elections involving hydrological and meteorological disasters, Natives tend to vote statistically significantly less than Whites in total population percentage. This study cannot explain why hydrological and meteorological disasters prompt such behavior. An increase in voting under geophysical disasters, may have a causation with location of the Native reservation location not near an earthquake fault line.

Two or more race voters tend to statistically and significantly vote more than Whites in terms of total population in meteorological events with and without election variables in all four elections. This begs the question, why do Two or more race voters have more statistical significance under meteorological disasters in all four types of elections? These are the only citizens who consistently vote statistically more than Whites in terms of total population in each of these four elections. This voting behavior diametrically opposes the behavior of Asians, Hispanics, and Natives for the same election and meteorological disaster. Why does this behavior not carry over to the the other three disaster categories?

This study shows that natural disasters do have an influence upon all four elections but the impact varies with type and the minority group. Minorities are not homogeneous groups thus in voting behavior to make a broad conclusion that covers all minority groups has no possibility of statistical significance with these models.

This study does not consider how redistricting House districts may impact the minority voter and natural disasters. Every ten years the House district boundaries are redrawn to represent the latest census count. This redistricting affects all voters but may, depending on the state, party controlling the state legislature, whether or not the state has a non-partisan electoral commission drawing the district boundary maps, impact minorities in greater or lesser numbers. This becomes an exogenous factor that may have an impact on the model's regression analysis.

Many of these elections overlap, e.g., House, POTUS, and $\frac{1}{3}$ of the Senate. Governors have a different election cycle that depends upon the state. This study separated each of these elections because of conflicts with duplicate panel data disasters. Some trends do though appear in the data results. House, POTUS, Senate, and governor elections with meteorological disaster interactions and added election variables, show the same statistical significance: Asians, Hispanics, and Natives tend to vote less than Whites in terms of total population percentage and Two or more races tend to vote more than Whites in terms of total population. Only one exception in the above statement concerns Blacks who vote statistically significantly less than Whites in terms of total population percentage in governor elections with meteorological disasters and added election variables.

Meteorological disasters may have the strongest evidence for answering the research questions of this study. One explanation for meteorological disasters is EM-DAT requirements for a disaster at least one of the following: 10 or more dead, 100 or more people affected, a declaration of a state of emergency (catholique de Louvain, 2019). Meteorological disasters include extra-tropical (Nor'easter), tropical (hurricanes), and convective storms (localized thunderstorms (with heavy rain and/or hail, lightning, high winds, tornadoes) to meso-scale, multi-day events. Under this criteria and types of storms, meteorological disasters have the most frequency and impact the greatest number of people causing the most damage. It seems reasonable to expect meteorological disasters have more affect on elections because of the number of affected people.

The second most frequent disaster are hydrological disasters which have the second most frequency to meteorological disasters. Within the hydrological regressions there are the oddities of Two or more voting statistically more in House and POTUS elections while Asians and Natives statistically vote less in the same elections. Again the the question why needs asked.

Climatological had 12 and geophysical had 20 disaster events in this study's timeframe, 1990-2016. Of these climatological events occurred in 4 states and geophysical in 2 states.

Because of the low frequency of disasters one must consider the small sample size when interpreting those regression results.

One possibility for explaining the differences within minority groups comes from the makeup of the minority group. Chinese, Filipinos, Vietnamese, Koreans, Japanese, and Indians are the the largest of America's Asian groups. Although they are Asian they are not a homogenous group. Chinese and Indians speak different languages, Japanese and Filipinos may have different religions, and each of these groups have different customs and cultures. Yet, they are grouped in a homogenous variable and the differences dismissed and thus disguised in the regression analysis. The same issue exists in Hispanics, e.g. Cuban Americans and Mexican Americans. These Hispanics have different cultures and language variations yet again are clumped together in one variable, Hispanics. Blacks, native and foreign born, and Native Americans are classified similarly as the previous groups even though differences exist. Most of the Two or more race people in this dataset come primarily from two locations, Hawaii and eastern Oklahoma. This may explain some of the anomaly of this race category results. More likely this race category lacks accuracy because of undercounting in the census.

Election candidates need aware of these differences between the election turnout of minorities. This study shows candidates, especially in a highly contested race, that minorities may make the difference between winning and losing especially with the changing of American demographics. Based on this study Asians and Hispanics are more statistically significant in all four elections and Asians by far more inclined to vote than their Hispanic neighbors. Blacks are disengaged, according to the regression results, from the political process by all four elections but this could change if candidates possibly appealed to them and fulfilled their promises to these constituents. House and Senate candidates need to engage Natives as well because they too are not involved in voting under nearly all disaster conditions.

The Democrat percentage in terms of the DV, election candidate total to potential total voting population, in all of the regression models have positive statistical significance.

4.1 Future research

This study evaluated minority races and ethnicities on a county level. Whites were excluded from the study but future research on natural disasters could study the effect on White voters to examine if the results show similar results in the same disaster counties. If the assumption for this study holds, Whites will vote regardless of a disaster or not, such a study would determine if the assumption has validity.

Time is not addressed in this study except for the year the disaster occurred and the election. Future research could calculate the number of days/weeks/months from the date of the disaster to the election. This would specifically determine if time needs considered in the analysis. Does a disaster in January have the same impact as one in late October before the election? If these disasters do impact the election, what is the tipping point in terms of time that the effect occurs? Six weeks or six months? These hypothetical questions would further the disaster and voting behavior literature.

Geographical location as in terms of voting also provides future analysis especially within or between states or county regions. For example, Oklahoma leads the nation in meteorological disasters with 45, Indiana and Kentucky have 17 and 12, respectfully. Table 9. Within these three states does voter behavior change when compared between these states and does behavior change between disaster counties and those non-disaster counties in the same state? These questions need considered in future research.

5 Appendix

5.1 Governor statistical diagnostic checks

The following statistical summary, xtsum results, and other various checks for heteroscedasticity, test for random effects, Hausman test, Wooldridge autocorrelation test, modified Wald test for group-wise heteroscedasticity in the fixed effect regression, and the Breusch-Pagan LM test of independence.

Overall statistics are "between" statistics are calculated on the basis of summary statistics of 3,113 regardless of year. "Within" statistics are calculated on the basis of summary statistics of 6.84838 year regardless of FIPS.

The Breusch and Pagan Lagrangian multiplier test shows to reject the null and this study will then not use Ordinary Least Squares Regression (OLS) because of significant differences across FIPS. The Hausman test results has a p-value of 0.0000 requiring a rejection of the null hypothesis so this study will use the fixed effects model.

The modified Wald test for groupwise heteroskedasticity in the fixed effects regression shows homoscedasticity exits in this model as the p-value equals zero.

The Wooldridge test for autocorrelation in panel data tests, shown below, indicates H_0: no first-order autocorrelation.

The Breusch-Pagan LM test of independence has too few common observations across the panel.

Table 20: Governor xtsum results

	Mean	**Std. Dev.**	**Min**	**Max**	**N/n/T-bar**
climatalogical overall	0.000546	0.0233613	0	1	N=21977
between		0.0116149	0	0.5	n=3113
within		0.0198928	-0.499454	0.875546	T-bar=7.059749
geophysical overall	0.00091	0.0301539	0	1	N=21977
between		0.011894	0	0.25	n=3113
within		0.0273862	-0.24909	0.87591	T-bar=7.059749
hydrological overall	0.0021386	0.0461966	0	1	N=21977
between		0.0173439	0	0.1666667	n=3113
within		0.0428408	-0.1645281	0.8771386	T-bar=7.059749
meteorological overall	0.0082359	0.0903793	0	1	N=21977
between		0.033265	0	0.2857143	n=3113

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Table 20 – continued from previous page

	Mean	Std. Dev.	Min	Max	N/nT-bar
within		0.0840266	-0.2774784	0.8832359	T-bar=7.059749
gov margin overall	6001.586	19730.45	0	705745	N=21977
between		16639.81	15.85714	322055.8	n=3113
within		10204.69	-272422.2	389690.8	T-bar=7.059749
gov Dem % overall	0.427338	0.1504757	0.0108	0.9161	N=21977
between		0.1059191	0.1098286	0.8467143	n=3113
within		0.1067461	0.0105952	0.8649095	T-bar=7.059749
Asian % overall	0.0095787	0.0256379	0	0.6630407	N=21977
between		0.0248199	0	0.5906883	n=3113
within		0.0057462	-0.104027	0.1127218	T-bar=7.059749
Black % overall	0.0801489	0.1339061	0	0.8415765	N=21977
between		0.1345151	0	0.836018	n=3113
within		0.0118219	-0.1856296	0.3030092	T-bar=7.059749
Hispanic % overall	0.057315	0.1143257	0	0.9741961	N=21977
between		0.1123045	0	0.9647408	n=3113
within		0.0212441	-0.1453889	0.2344527	T-bar=7.059749
Native % overall	0.0134532	0.0564479	0	0.9252143	N=21977
between		0.0567458	0	0.9135526	n= 3113
within		0.0042865	-0.0986582	0.1011749	T-bar=7.059749
Two % overall	0.0053132	0.0079057	0	0.1959335	N=21977
between		0.0050002	0	0.1050165	n=3113
within		0.0061282	-0.0997033	0.0962302	T-bar=7.059749

Overall statistics are ordinary statistics that are based on 21,977 observations. “Between” statistics are calculated on the basis of summary statistics of 3,113 regardless of year. “Within” statistics are calculated on the basis of summary statistics of 7.059749 year regardless of FIPS.

Table 21: Governor disaster, election, and race correlations

	climatological	**geophysical**	**hydrological**	**meteorological**	**gov margin**	**gov Dem %**	**Asian %**	**Black %**	**Hispanic %**	**Native %**	**Two %**
climatological	1										
geophysical	0.0639	1									
hydrological	0.0411	0.0313	1								
meteorological	-0.0021	-0.0028	-0.0042	1							
gov margin	0.1039	0.1037	0.0193	0	1						
gov Dem %	-0.0043	0.0076	0.0154	0.0148	0.0767	1					
Asian %	0.0674	0.101	0.0503	-0.0041	0.3723	0.0706	1				
Black %	-0.0047	-0.0075	0.0045	-0.0027	0.0716	0.2806	0.0127	1			
Hispanic %	0.0451	0.0448	0.0283	-0.0172	0.1045	-0.0158	0.1374	-0.0907	1		
Native %	-0.0028	-0.003	-0.0077	0.0008	-0.0357	0.0838	-0.0366	-0.0849	-0.0167	1	
Two %	0.0205	0.0379	0.0229	0.0491	0.0721	-0.0073	0.3644	-0.0558	0.0398	0.1955	1

Race and natural disasters, race and race show no correlation in the governor model has correlation for 21,977 observations.

5.2 House statistical diagnostics checks

Overall statistics are ordinary statistics that are based on 40,182 observations. Overall statistics are "between" statistics are calculated on the basis of summary statistics of 3,113 regardless of year. "Within" statistics are calculated on the basis of summary statistics of 12.90781 year regardless of FIPS.

The Breusch and Pagan Lagrangian multiplier test shows to reject the null and this study will then not use Ordinary Least Squares Regression (OLS) because of significant differences across FIPS. The Hausman test results has a p-value of 0.0000 requiring a rejection of the null hypothesis so this study will use the fixed effects model.

The modified Wald test for groupwise heteroskedasticity in the fixed effects regression shows homoscedasticity exits in this model as the p-value equals zero.

The Wooldridge test for autocorrelation in panel data tests, shown below, indicates H_0: no first-order autocorrelation.

The Breusch-Pagan LM test of independence has too few common observations across the panel.

Table 22: House xtsum results

		Mean	**Std. Dev.**	**Min**	**Max**	**N/n/T-bar**
climatalogical	overall	.0008959	.0299189	0	1	40182
	between		.011549	0	.3846154	3113
	within		.027594	-.3837195	.9239728	12.90781
geophysical	overall	.0005475	.0233928	0	1	40182
	between		.008022	0	.1538462	3113
	within		.0219643	-.1532986	.9236244	12.90781
hydrological	overall	.0034344	.0585035	0	1	40182
	between		.016166	0	.1538462	3113
	within		.0562415	-.1504118	.9265113	12.90781
meteorological	overall	.0126674	.1118357	0	1	40182
	between		.0337926	0	.3846154	3113
	within		.1066392	-.371948	.9357443	12.90781
margin	overall	9111.361	31841.2	0	1509302	40182

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Table 22 – continued from previous page

	Variable	Mean	Std. Dev.	Min	Max	N/n/T-bar
	between		28720.49	45.38462	788542.7	3113
	within		13604.69	-552779.3	729870.7	12.90781
house Dem %	overall	.4034307	.2195039	0	1	40182
	between		.1610331	.0541692	.9070308	3113
	within		.1490789	-.3568308	1.170592	12.90781
Asian %	overall	.0100352	.0257363	0	.6630407	40182
	between		.0250452	0	.5839941	3113
	within		.0056113	-.094246	.1321198	12.90781
Black %	overall	.0818106	.1350909	0	.841649	40182
	between		.1350392	0	.835332	3113
	within		.0112147	-.1769933	.3028204	12.90781
Hispanic %	overall	.0600416	.1164405	0	.9741961	40182
	between		.1143582	.001244	.9642776	3113
	within		.0202377	-.1448628	.2294861	12.90781
Native %	overall	.0136615	.0569062	0	.9326445	40182
	between		.0571286	0	.9163974	3113
	within		.0039381	-.0889121	.086662	12.90781
Two %	overall	.0060619	.0082955	0	.1984241	40182
	between		.0058681	0	.1273352	3113
	within		.0058599	-.1212733	.0771507	12.90781

Table 23: House disaster, election, and race correlations

	climatological	**geophysical**	**hydrological**	**meteorological**	**gov margin**	**gov Dem %**	**Asian %**	**Black %**	**Hispanic %**	**Native %**	**Two %**
climatological	1										
geophysical	0.0349	1									
hydrological	0.0125	0.0168	1								
meteorological	0.004	-0.0027	0.0694	1							
house margin	0.1198	0.0601	0.0156	0.0352	1						
house Dem %	0.0051	0.0097	0.0224	-0.0148	0.107	1					
Asian %	0.0623	0.0706	0.0271	0.025	0.3821	0.1162	1				
Black %	-0.009	-0.0071	-0.0036	0.0074	0.0723	0.2139	0.0171	1			
Hispanic %	0.0391	0.0334	0.0011	0.0135	0.1091	0.0266	0.1382	-0.0913	1		
Native %	0.0032	-0.0009	-0.0101	-0.0081	-0.0367	0.0901	-0.0394	-0.0863	-0.0188	1	
Two %	0.0305	0.025	0.0143	0.0407	0.0831	-0.0221	0.3991	-0.0555	0.0333	0.2122	1

Race and natural disasters, race and race show no correlation. Disasters and disasters, disasters and election variables used in this study show no correlation.

5.3 POTUS statistical diagnostic checks

Overall statistics are ordinary statistics that are based on 21,786 observations. Overall statistics are "between" statistics are calculated on the basis of summary statistics of 3,114 regardless of year. "Within" statistics are calculated on the basis of summary statistics of 6.996146 year regardless of FIPS.

The Breusch and Pagan Lagrangian multiplier test shows to reject the null and this study will then not use Ordinary Least Squares Regression (OLS) because of significant differences across FIPS. The Hausman test results has a p-value of 0.0000 requiring a rejection of the null hypothesis so this study will use the fixed effects model.

The modified Wald test for groupwise heteroskedasticity in the fixed effects regression shows homoscedasticity exits in this model as the p-value equals zero.

The Wooldridge test for autocorrelation in panel data tests, shown below, indicates H_0: no first-order autocorrelation.

The Breusch-Pagan LM test of independence has too few common observations across the panel.

Table 24: POTUS xtsum results

		Mean	**Std. Dev.**	**Min**	**Max**	**N/n/T-bar**
climatalogical	overall	.0011934	.0345262	0	1	N=21786
	between		.0134959	0	.2857143	n=3114
	within		.0317784	-.2845209	.8583363	T-bar=6.996146
geophysical	overall	.0005508	.0234635	0	1	N=21786
	between		.0088525	0	.1428571	n=3114
	within		.0217289	-.1423063	.8576937	T-bar=6.996146
hydrological	overall	.0043606	.0658922	0	1	N=21786
	between		.0245723	0	.1428571	n=3114
	within		.0611378	-.1384965	.8615035	T-bar=6.996146
meteorological	overall	.017167	.1298963	0	1	N=21786
	between		.0524157	0	.5714286	n=3114
	within		.1188489	-.5542616	.8743098	T-bar=6.996146

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Table 24 – continued from previous page

		Mean	Std. Dev.	Min	Max	N/n/T-bar
POTUS margin	overall	8267.863	36078.93	0	1694621	N=21786
	between		34258.54	18.14286	1052387	n=3114
	within		11302.47	-397197.6	650501.4	T-bar=6.996146
POTUS Dem %	overall	.3911254	.1341619	.0314	.9246	N=21786
	between		.118289	.0962429	.8834286	n=3114
	within		.0634818	.0515396	.6221111	T-bar=6.996146
Asian %	overall	.0100607	.0256282	0	.6489763	N=21786
	between		.0249467	0	.5807456	n=3114
	within		.0058846	-.0929821	.1333933	T-bar=6.996146
Black %	overall	.082643	.1356434	0	.8389262	N=21786
	between		.1351157	0	.8352631	n=3114
	within		.01189	-.1715435	.3029644	T-bar=6.996146
Hispanic %	overall	.0599505	.1162497	0	.972569	N=21786
	between		.1142726	.0021331	.964191	n=3114
	within		.0212962	-.1425652	.2299442	T-bar=6.996146
Native %	overall	.0136298	.0565032	0	.9326445	N=21786
	between		.0570085	0	.9159086	n=3114
	within		.0040688	-.0855463	.0867093	T-bar=6.996146
Two %	overall	.0062902	.0083898	0	.1984241	N=21786
	between		.0060674	0	.1314632	n=3114
	within		.0057946	-.125173	.073251	T-bar=6.996146

Table 25: POTUS disaster, election, and race correlations

	climatological	**geophysical**	**hydrological**	**meteorological**	**gov margin**	**gov Dem %**	**Asian %**	**Black %**	**Hispanic %**	**Native %**	**Two %**
climatological	1										
geophysical	-0.0008	1									
hydrological	-0.0023	-0.0016	1								
meteorological	0.0057	-0.0031	0.0985	1							
potus margin	0.1194	0.0407	0.008	0.0439	1						
potus Dem %	0.0165	0.0019	0.004	0.0263	0.2141	1					
Asian %	0.0575	0.0339	0.0143	0.043	0.3763	0.2287	1				
Black %	-0.0118	-0.008	-0.0071	0.016	0.0862	0.3951	0.017	1			
Hispanic %	0.0366	0.0361	-0.0151	0.0289	0.1188	0.0797	0.1395	-0.0922	1		
Native %	0.0069	0	-0.0114	-0.0162	-0.0298	0.0987	-0.0391	-0.0869	-0.0178	1	
Two %	0.0373	-0.0121	0.0064	0.0328	0.093	-0.022	0.4082	-0.0576	0.0346	0.2186	1

Race and natural disasters, race and race show no correlation. Disasters and disasters, disasters and election variables used in this study show no correlation.

5.4 Senate statistical diagnostic checks

Overall statistics are ordinary statistics that are based on 28,860 observations. Overall statistics are "between" statistics are calculated on the basis of summary statistics of 3,113 regardless of year. "Within" statistics are calculated on the basis of summary statistics of 9.2708 year regardless of FIPS.

The Breusch and Pagan Lagrangian multiplier test shows to reject the null and this study will then not use Ordinary Least Squares Regression (OLS) because of significant differences across FIPS. The Hausman test results has a p-value of 0.0000 requiring a rejection of the null hypothesis so this study will use the fixed effects model.

The modified Wald test for groupwise heteroskedasticity in the fixed effects regression shows homoscedasticity exits in this model as the p-value equals zero.

The Wooldridge test for autocorrelation in panel data tests, shown below, indicates H_0: no first-order autocorrelation.

The Breusch-Pagan LM test of independence has too few common observations across the panel.

Table 26: Senate xtsum results

		Mean	**Std. Dev.**	**Min**	**Max**	**N/n/T-bar**
climatalogical	overall	.0008663	.0294199	0	1	N=28860
	between		.0124065	0	.3333333	n=3113
	within		.0267605	-.3324671	.8897551	T-bar=9.2708
geophysical	overall	.0005891	.0242636	0	1	N=28860
	between		.0102684	0	.2222222	n=3113
	within		.0220413	-.2216332	.90968	T-bar=9.2708
hydrological	overall	.0032918	.0572803	0	1	N=28860
	between		.0184646	0	.1111111	n=3113
	within		.054213	-.1078194	.9123827	T-bar=9.2708
meteorological	overall	.0122661	.110073	0	1	N=28860
	between		.0381663	0	.3333333	n=3113
	within		.1031136	-.3210672	.921357	T-bar=9.2708
senate margin	overall	7632.149	30616.69	0	1314730	N=28860

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Table 26 – continued from previous page

		Mean	Std. Dev.	Min	Max	N/n/T-bar
	between		27491.19	18.22222	735509.9	n=3113
	within		13574.04	-494527.6	593770.4	T-bar=9.2708
senate Dem %	overall	.4284418	.1662094	0	1	N=28860
	between		.1222889	.0958692	.8485222	n=3113
	within		.1134283	-.1292995	1.019145	T-bar=9.2708
Asian %	overall	.0096977	.026415	0	.6630407	N=28860
	between		.0249233	0	.5837483	n=3113
	within		.0058409	-.0902508	.1243725	T-bar=9.2708
Black %	overall	.0822641	.1352777	0	.841649	N=28860
	between		.1346082	0	.8350096	N=3113
	within		.0117999	-.1768639	.3065949	T-bar=9.2708
Hispanic %	overall	.0573281	.1135888	0	.972569	N=28860
	between		.1129884	0	.9646037	n=3113
	within		.0211406	-.1452609	.2405585	T-bar=9.2708
Native %	overall	.0136004	.0557783	0	.9326445	N=28860
	between		.0566341	0	.9139262	n=3113
	within		.0041881	-.0938215	.0860433	T-bar=9.2708
Two %	overall	.0056237	.0084101	0	.1984241	N=28860
	between		.0051822	0	.1181871	n=3113
	within		.0063695	-.1125634	.0858607	T-bar=9.2708

Table 27: Senate disaster, election, and race correlations

	climatological	**geophysical**	**hydrological**	**meteorological**	**gov margin**	**gov Dem %**	**Asian %**	**Black %**	**Hispanic %**	**Native %**	**Two %**
climatological	1										
geophysical	0.0478	1									
hydrological	0.0189	0.0235	1								
meteorological	0.0074	-0.0027	0.0925	1							
senate margin	0.0949	0.0599	0.0104	0.0324	1						
senate Dem %	0.0148	0.0008	0.0029	0.0125	0.1355	1					
Asian %	0.0623	0.0603	0.0385	0.0265	0.3659	0.1409	1				
Black %	-0.0084	-0.0078	0.0047	0.002	0.0708	0.2031	0.0125	1			
Hispanic %	0.0469	0.0373	0.0096	0.0208	0.1108	-0.022	0.1334	-0.0899	1		
Native %	0.002	-0.0012	-0.0092	-0.0027	-0.0315	0.0925	-0.0373	-0.0869	-0.0184	1	
Two %	0.019	0.0214	0.0294	0.0536	0.0919	-0.0397	0.4047	-0.0497	0.0452	0.1939	1

Race and natural disasters, race and race show no correlation in the Senate model. This correlation table is based upon 28,860 observations.

Bibliography

Abadie, A., Diamond, A. and Hainmueller, J. (2010), 'Synthetic control methods for comparative case studies: Estimating the effect of california's tobacco control program', *Journal of the American statistical Association* **105**(490), 493–505.

Abney, F. G. and Hill, L. B. (1966), 'Natural disasters as a political variable: The effect of a hurricane on an urban election', *American Political Science Review* **60**(4), 974–981.

Achen, C. H. and Bartels, L. M. (2004), 'Blind retrospection: Electoral responses to drought, flu, and shark attacks', *Estudio/Working Paper 2004/199* .

Achen, C. H. and Bartels, L. M. (2017), *Democracy for realists: Why elections do not produce responsive government*, Princeton University Press.

Albala-Bertrand, J.-M. (1993), 'Natural disaster situations and growth: A macroeconomic model for sudden disaster impacts', *World Development* **21**(9), 1417–1434.

Aldrich, J. H. (1993), 'Rational choice and turnout', *American journal of political science* pp. 246–278.

Anbarci, N., Escaleras, M. and Register, C. A. (2005), 'Earthquake fatalities: the interaction of nature and political economy', *Journal of Public Economics* **89**(9-10), 1907–1933.
URL: *http://dx.doi.org/10.1016/j.jpubeco.2004.08.002*

Andrews, W. G. (1966), 'American voting participation', *The Western Political Quarterly* **19**(4), 639–642.

Antunes, G. and Gaitz, C. M. (1975), 'Ethnicity and participation: A study of mexican-americans, blacks, and whites', *American Journal of Sociology* **80**(5), 1192–1211.

Arceneaux, K. and Stein, R. M. (2006), 'Who is held responsible when disaster strikes? the attribution of responsibility for a natural disaster in an urban election', *Journal of Urban Affairs* **28**(1), 43–53.

Artés, J. (2014), 'The rain in spain: Turnout and partisan voting in spanish elections', *European Journal of Political Economy* **34**, 126–141.

Ashworth, S., Bueno de Mesquita, E. and Friedenberg, A. (2018), 'Learning about voter rationality', *American Journal of Political Science* **62**(1), 37–54.

Austin, S. D. W., Middleton, R. T. and Yon, R. (2012), 'The effect of racial group consciousness on the political participation of african americans and black ethnics in miami-dade county, florida', *Political Research Quarterly* **65**(3), 629–641.

Bass, L. E. and Casper, L. M. (2001), 'Impacting the political landscape: Who registers and votes among naturalized americans?', *Political Behavior* **23**(2), 103–130.

Benali, Nadia and Saidi, Kais (2017), 'A robust analysis of the relationship between natural disasters, electricity and economic growth in 41 countries', *Journal of Economic Development* **42**(3), 89–109.

Bertrand, M., Duflo, E. and Mullainathan, S. (2004), 'How much should we trust differences-in-differences estimates?', *The Quarterly journal of economics* **119**(1), 249–275.

Bhatt, M. R. (2012), 'Disaster response preparedness in india and china', *Economic and Political Weekly* pp. 25–27.

Bodet, M. A., Thomas, M. and Tessier, C. (2016), 'Come hell or high water: An investigation of the effects of a natural disaster on a local election', *Electoral Studies* **43**, 85–94.

Brady, H. E., Verba, S. and Schlozman, K. L. (1995), 'Beyond ses: A resource model of political participation', *American political science review* pp. 271–294.

Brancati, D. (2007), 'Political aftershocks: The impact of earthquakes on intrastate conflict', *Journal of Conflict Resolution* **51**(5), 715–743.

Carlin, R. E., Love, G. J. and Zechmeister, E. J. (2014*a*), 'Natural disaster and democratic legitimacy: The public opinion consequences of chile's 2010 earthquake and tsunami', *Political Research Quarterly* **67**(1), 3–15.

Carlin, R. E., Love, G. J. and Zechmeister, E. J. (2014*b*), 'Trust shaken: Earthquake damage, state capacity, and interpersonal trust in comparative perspective', *Comparative Politics* **46**(4), 419–453.

Cassel, C. A. (2002), 'Hispanic turnout: Estimates from validated voting data', *Political Research Quarterly* **55**(2), 391–408.

catholique de Louvain, U.-C. U. (2019), 'EM-DAT: The Emergency Events Database'.
URL: *www.emdat.be*

Cavallo, E. A. and Noy, I. (2009), 'The economics of natural disasters: a survey', *IDB Working Paper* (35).
URL: *Cavallo, Eduardo A. and Noy, Ilan, The Economics of Natural Disasters: A Survey (December 2009). IDB Working Paper No. 35, Available at SSRN: https://ssrn.com/abstract=1817217 or http://dx.doi.org/10.2139/ssrn.1817217*

Coffman, M. and Noy, I. (2012), 'Hurricane iniki: measuring the long-term economic impact of a natural disaster using synthetic control', *Environment and Development Economics* **17**(2), 187–205.

Dawson, M. C., Brown, R. E. and Allen, R. L. (1990), 'Racial belief systems, religious guidance, and african-american political participation', *National Political Science Review* **2**(1), 22–44.

de Mesquita, B. B., Smith, A., Morrow, J. D. and Siverson, R. M. (2005), *The logic of political survival*, MIT press.

Desai, B., Maskrey, A., Peduzzi, P., De Bono, A. and Herold, C. (2015), 'Making development sustainable: the future of disaster risk management, global assessment report on disaster risk reduction', *United Nations Office for Disaster Risk Reduction (UNISDR)* .

DeSipio, L. (1998), *Counting on the Latino vote: Latinos as a new electorate*, University of Virginia Press.

Diaz, M.-E. D. (2012), 'Asian embeddedness and political participation: Social integration and asian-american voting behavior in the 2000 presidential election', *Sociological Perspectives* **55**(1), 141–166.

duPont IV, W. and Noy, I. (2015), 'What happened to kobe? a reassessment of the impact of the 1995 earthquake in japan', *Economic Development and Cultural Change* **63**(4), 777–812.

Elliott, J. R. (2014), 'Natural hazards and residential mobility: General patterns and racially unequal outcomes in the united states', *Social Forces* **93**(4), 1723–1747.

ESRI (2019), 'Faq:what are fips codes?'.
URL: *https://support.esri.com/en/technical-article/000002594*

Ferman, B. and Pinto, C. (2016), 'Revisiting the synthetic control estimator', *MPRA Working Paper* **No. 86495**.

Flores, A. Q. and Smith, A. (2012), 'Leader survival and natural disasters', *British Journal of Political Science* **43**(4), 821–843.

Fraga, B. L. (2016), 'Candidates or districts? reevaluating the role of race in voter turnout', *American Journal of Political Science* **60**(1), 97–122.

Fussell, E., Curran, S. R., Dunbar, M. D., Babb, M. A., Thompson, L. and Meijer-Irons, J. (2017), 'Weather-related hazards and population change: a study of hurricanes and tropical storms in the united states, 1980–2012', *The Annals of the American Academy of Political and Social Science* **669**(1), 146–167.

Fussell, E., Curtis, K. J. and DeWaard, J. (2014), 'Recovery migration to the city of new orleans after hurricane katrina: a migration systems approach', *Population and environment* **35**(3), 305–322.

Gasper, J. and Reeves, A. (2010), Governors as opportunists: evidence from disaster declaration requests, *in* 'APSA 2010 Annual Meeting Paper'.

Gasper, J. T. and Reeves, A. (2011), 'Make it rain? retrospection and the attentive electorate in the context of natural disasters', *American Journal of Political Science* **55**(2), 340–355.

Gatrell, J. D. and Bierly, G. D. (2002), 'Weather and voter turnout: Kentucky primary and general elections, 1990-2000', *Southeastern Geographer* **42**(1), 114–134.

Gee, B., Bella, T., Bellware, K., Cappucci, M. and Kronfield, M. (2020), 'Tornadoes kill at least 19 people, leave trail of destruction in and around Nashville'.
URL: *http:*
www.washingtonpost.com

Gomez, B. T., Hansford, T. G. and Krause, G. A. (2007), 'The republicans should pray for rain: Weather, turnout, and voting in us presidential elections', *The Journal of Politics* **69**(3), 649–663.

Habibur Rahman, M., Anbarci, N., Bhattacharya, P. S. and Ulubaşoğlu, M. A. (2017), 'The shocking origins of political transitions: Evidence from earthquakes', *Southern Economic Journal* **83**(3), 796–823.

Harris, F. C. (1994), 'Something within: Religion as a mobilizer of african-american political activism', *The Journal of Politics* **56**(1), 42–68.

Healy, A. and Malhotra, N. (2009), 'Myopic voters and natural disaster policy', *American Political Science Review* pp. 387–406.

Healy, A. and Malhotra, N. (2010), 'Random events, economic losses, and retrospective voting: Implications for democratic competence (research note)'.

Heersink, B., Peterson, B. D. and Jenkins, J. A. (2017), 'Disasters and elections: Estimating the net effect of damage and relief in historical perspective', *Political Analysis* **25**(2), 260–268.

Herrick, R., Davis, J. and Pryor, B. (2020), 'Are indigenous americans unique in their voting in us national elections?', *Politics, Groups, and Identities* pp. 1–19.

Highton, B. and Burris, A. L. (2002), 'New perspectives on latino voter turnout in the united states', *American Politics Research* **30**(3), 285–306.

Integrated Research on Disaster Risk (2014), Peril classification and hazard glossary, Technical report, DATA Project Report.

James, T. S. and Alihodzic, S. (2020), 'When is it democratic to postpone an election? elections during natural disasters, covid-19, and emergency situations', *Election Law Journal: Rules, Politics, and Policy* **19**(3), 344–362.

Jang, S.-J. (2009), 'Get out on behalf of your group: Electoral participation of latinos and asian americans', *Political Behavior* **31**(4), 511–535.

Lasala-Blanco, N., Shapiro, R. Y. and Rivera-Burgos, V. (2017), 'Turnout and weather disruptions: Survey evidence from the 2012 presidential elections in the aftermath of hurricane sandy', *Electoral Studies* **45**, 141–152.

Lay, J. C. (2009), 'Race, retrospective voting, and disasters: The re-election of c. ray nagin after hurricane katrina', *Urban Affairs Review* **44**(5), 645–662.

Leighley, J. E. and Vedlitz, A. (1999), 'Race, ethnicity, and political participation: Competing models and contrasting explanations', *The Journal of Politics* **61**(4), 1092–1114.

Leip, D. (2016), 'Dave leip's atlas of us presidential elections'.

Lien, P. (2004), 'Asian americans and voting participation: Comparing racial and ethnic differences in recent us elections', *International Migration Review* **38**(2), 493–517.

Lijphart, A. (1997), 'Unequal participation: democracy's unresolved dilemma', *American political science review* pp. 1–14.

Lind, J. T. (2014), 'Rainy day politics - an instrumental variables approach to the effect of parties on political outcomes', *CESifo Working Paper No 4911* .

Mas-Colell, A., Whinston, M. D., Green, J. R. et al. (1995), *Microeconomic theory*, Vol. 1, Oxford university press New York.

McCoy, S. J. and Walsh, R. P. (2018), 'Wildfire risk, salience & housing demand', *Journal of Environmental Economics and Management* **91**, 203–228.

Meier, A. N., Schmid, L. D. and Stutzer, A. (2016), 'Rain, emotions and voting for the status quo', *IZA Discussion Papers No. 10350* **Institute for the Study of Labor (IZA), Bonn**.

Milbrath, L. W. and Goel, M. L. (1977), *Political participation: How and why do people get involved in politics?*, Rand McNally College Publishing Company.

Min, J. and Savage, D. (2012), 'The influence of socio-economic characteristics on the political attitudes of american indians', *The Social Science Journal* **49**(4), 494–502.

Mohan, P. S., Ouattara, B. and Strobl, E. (2018), 'Decomposing the macroeconomic effects of natural disasters: A national income accounting perspective', *Ecological economics* **146**, 1–9.

Morley, M. T. (2017), 'Election emergencies: Voting in the wake of natural disasters and terrorist attacks', *Emory LJ* **67**, 545.

NOAA (2019), 'NOAA National Centers for Environmental Information (NCEI) U.S. Billion-Dollar Weather and Climate Disasters'.
URL: *https://www.ncdc.noaa.gov/billions/*

NOAA (2020), 'Nashville, tn weather forecast office march 2-3, 2020 tornadoes and severe weather'.
URL: *https://www.weather.gov/ohx/20200303*

Olson, R. S. and Gawronski, V. T. (2010), 'From disaster event to political crisis: A "5c+a" framework for analysis', *International Studies Perspectives* **11**(3), 205–221.

Poon, L. (2020), 'What happens to voting when there's a natural disaster'.
URL: *https://www.bloomberg.com/news/articles/2020-10-30/when-hurricanes-and-wildfires-di*

Potluka, O. and Slavikova, L. (2010), 'Impact of floods on local political representation', *Acta Politologica* **2**(1), 1–17.

Ramos, R. and Sanz, C. (2018), 'Backing the incumbent in difficult times; the electoral impact of wildfires', *Banco de Espana Working Paper* **No. 1810**.
URL: *https://ssrn.com/abstract=3135155*

Rice, D. (2018), 'Michael officially stronger than katrina at landfall'.
URL: *https://www.usatoday.com/story/news/nation/2018/10/11/hurricane-michael-stronger-than-katrina-andrew-landfall/1600168002/*

Riker, W. H. and Ordeshook, P. C. (1968), 'A theory of the calculus of voting', *American political science review* **62**(1), 25–42.

Rissmann, M. P. (2016), 'Disastrous voting: The impact of natural disasters on incumbents' electoral performance', *ResearchGate Working Paper* .

Rissmann, M. P. (2018), Disastrous Voting, PhD thesis, University of Nevada-Las Vegas.

Rivera, J. D. and Miller, D. S. (2007), 'Continually neglected: Situating natural disasters in the african american experience', *Journal of black studies* **37**(4), 502–522.

Sekhon, J. S. and Titiunik, R. (2012), 'When natural experiments are neither natural nor experiments', *American Political Science Review* **106**(1), 35–57.

Sinclair, B., Hall, T. E. and Alvarez, R. M. (2011), 'Flooding the vote: Hurricane katrina and voter participation in new orleans', *American politics research* **39**(5), 921–957.

Skopek, T. and Garner, A. (2014), 'The disappearing turnout gap between native americans and non-native americans', *American Indian culture and research journal* **38**(2), 1–16.

Sugg, A. L. (1966), 'The hurricane season of 1965', *Monthly Weather Review* **94**(3), 183–191.

Tate, K. (1991), 'Black political participation in the 1984 and 1988 presidential elections', *The American Political Science Review* pp. 1159–1176.

Tate, K. (1994*a*), *From protest to politics: The new black voters in American elections*, Harvard University Press.

Tate, K. (1994*b*), *From protest to politics: The new black voters in American elections*, Harvard University Press.

Tversky, A. and Kahneman, D. (1974), 'Judgment under uncertainty: Heuristics and biases', *Science* **185**(4157), 1124–1131.
URL: *http://www.jstor.org/stable/1738360*

US Bureau of the Census (2003), 'Intercensal state and county characteristics population estimates with 1990-base race groups'.
URL: *https://data.nber.org/census/popest/www.census.gov/popest/data/intercensal/st−co/files*

US Bureau of the Census (2012), 'Intercensal Estimates of the Resident Population by Sex, Race, and Hispanic Origin for Counties: April 1, 2000 to July 1, 2010'.
URL: *https://www2.census.gov/programs−surveys/popest/technical−documentation/file−layouts/20*

USGS (n.d.), 'Kilauea'.
URL: *https://volcanoes.usgs.gov/volcanoes/kilauea/*

Van Aalst, M. K. (2006), 'The impacts of climate change on the risk of natural disasters', *Disasters* **30**(1), 5–18.

Velez, Y. and Martin, D. (2013), 'Sandy the rainmaker: The electoral impact of a super storm', *PS, Political Science & Politics* **46**(2), 313.

Verba, S. (1996), 'The citizen as respondent: sample surveys and american democracy presidential address, american political science association, 1995', *American Political Science Review* pp. 1–7.

Visconti, G. (2018), Political Preferences in Adverse Conditions, PhD thesis, Columbia University.

Vowels, J., Coffé and Curtin, J. (2017), *Inequalities in participation*, ANU Press, chapter 11, pp. 241–268.
URL: *http://www.jstor.org/stable/j.ctt1vw0p68.17*

Ward, P. S. and Shively, G. E. (2017), 'Disaster risk, social vulnerability, and economic development', *Disasters* **41**(2), 324–351.

Whittington-Kaminski, L. (2019), 'Hurricanes hit just before election season — why aren't we more prepared?'.
URL: *https://talkingpointsmemo.com/cafe/hurricanes−voter−disenfranchisement*

Williams, D. (2006), 'Reconstructing section 5: A post-katrine proposal for voting rights act reform', *Yale LJ* **116**, 1116.

Wolfers, J. et al. (2002), 'Are voters rational?: Evidence from gubernatorial elections', *Graduate School of Business, Stanford University.* .

Wuebbles, D. J., Fahey, D. W. and Hibbard, K. A. (2017), 'USGCRP: Climate science special report: fourth national climate assessment, volume 1', *U.S. Global Change Research Program* .
URL: *science2017.globalchange.gov*

Xu, J. (2002), 'The political behavior of asian americans: A theoretical approach', *Journal of Political and Military Sociology* **30**(1), 71.

Xu, J. (2005), 'Why do minorities participate less? the effects of immigration, education, and electoral process on asian american voter registration and turnout', *Social science research* **34**(4), 682–702.